COLONY OF MAURITIUS

THIRD ANNUAL REPORT OF THE SUGARCANE RESEARCH STATION, DEPARTMENT OF AGRICULTURE

MAURITIUS, 1932

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SUGARCANE RESEARCH STATION, MAURITIUS

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Third Annual Report of the Sugarcane Research Station, Mauritius for the year 1932

1. INTRODUCTION

The writer acted as Director of Agriculture from January 1st to March 3rd the day on which Mr G. E. Bodkin assumed duty.

With the arrival on March 31st of the newly appointed Physiological Botanist, Dr. H. Evans, the Station was up to full strength for the first time since its opening in January 1930. The need for this Officer's services had been felt for a considerable time as many problems connected with the growth and physiology of the sugar cane need thorough investigation.

At the present time very little is known as to how, when and where sucrose is found in the cane. Again, while the above-ground region of the sugar cane is a familiar subject for research, our knowledge of the underground system of the cane is extremely limited. Consequently, there is a real need for a comparative study of the root systems of the various cane varieties, throughout the seasons, in the different soils and climates of the island. Such a study should go hand in hand with an investigation into the various functions of the different organs and tissues of the whole plant. Dr. Evans' main programme of work has therefore been laid down as follows :—

1. The investigation of the course of growth throughout the crop year.

2. The analysis and reconstruction of the various root types found.

3. The investigation of root growth throughout the crop year.

With regard to the last two items of this programme, it is hoped that the results of these root studies will also indicate for which root types to breed when considering the resistance or tolerance of new cane seedlings to the attacks of Phytalus Smithi, a local pest that so far has defied control. It may be noted here that Phytalus larvæ are normally found in the top 9" of soil, the region in which noble cane types develop their root systems whereas Nobilised Glagah types have been found with roots situated in a lower zone below the usual Phytalus region. The breeding of deep rooted seedlings may possibly solve the Phytalus problem in time.

In addition to the above programme, Dr. Evans will undertake several minor investigations as time permits. The results of one such investigation already carried out are of particular interest showing that the mere soaking of setts or cuttings in various mixtures before planting has a definite and beneficial effect on both the rate and percentage germination.

A full report on Dr. Evans' work will be found in Part II of this report.

The Bio-Chemical Division of the station was in charge of Mr. N. Craig until July 20th when that Officer proceeded on leave. During the remainder of the year Mr. P. Halais, Scientific Assistant, took charge. The research work of this Division has been concerned chiefly with the continuation of the soil survey of the island, in order to define roughly the limits of the various soil types. Such work must be regarded as the foundation for all soil research, as without it the results of manurial and other trials conducted in one district cannot be applied to another.

As a result of the soil analyses conducted up to date the soils of the island can be divided roughly into three classes:—

1. Highly laterised soils of the high rainfall districts.
2. Red and black siliceous soils of the dry and hot districts.
3. Soils of the "Terre Franche" type intermediate between 1 and 2.

The laterised soils of class 1 above are characterised by low pH values, low or medium total exchange capacity and high lime requirements. As only small quantities of potash are usually present it is unlikely that much is available in exchangeable form. Class 2 above on the other hand is rich in exchangeable bases and in consequence more nearly neutral. Such soils contain a greater amount of potash and judging from the results obtained up to the present time there is a fair amount available in exchangeable form. With regard to the phosphates, analytical results up to date show that deficiency of available phosphate is of common occurrence. Where such deficiency exists experiment has shown that the application of soluble phosphate results in considerably increased yields.

Twelve of the fourteen manurial trials laid down on estates some time ago were harvested in 1932. These consisted of five nitrogen, five phosphate and two potash experiments, the results of which are given in full below. An analysis of these results shows that as regards the Nitrogen experiments, excepting in one case, no significant increase in yield has been observed to result from the applications of nitrogen given. Similar results were observed from five experiments conducted in the previous year suggesting the need for correctly designed nitrogen experiments on every estate. Of the phosphate experiments harvested, that at St. Aubin showed a significant and substantial increase in yield, resulting from the application of soluble phosphates, while an interesting relationship between the P_2O_5 content of the soil and the cane juice was observed. With regard to the two potash experiments one of these showed a small increase in yield resulting from the application of potash.

It is very necessary that these manurial experiments should be multiplied in number and extended until such time as significant results have been obtained from all over the island. It will then be possible to interpret correctly the analytical results of the soil survey and state the manurial requirements of the various soils on the different estates. Lime and coral sand experiments are being added to the series this year and where possible, buffer plots will be established between the treated plots and the controls, in order to minimise the risk of seepage.

The full report of the Biochemical Division including the results of manurial trials will be found in Part III of this report.

PART I

CANE BREEDING

General

The cane breeding policy of the station has remained unaltered since last year with the exception that Gummosis resistance trials have been introduced into the breeding programme for the first time. The breeding programe aims at the production by modern methods, of vigorous hybrid seedlings of high yielding and disease resisting powers to replace those varieties in the island which now prove inefficient judged in the light of recent results obtained elsewhere. The actual breeding work and testing is carried out in two districts, Réduit and Pamplemousses, so that selections are made for two definite zones, firstly the cool and damp uplands with an 18 months virgin crop and secondly the hotter and drier lowlands with a 12 months crop. Although we have been extremely fortunate in our work in the past 3 years so far as the production of large hybrid populations is concerned, the work has not been without its serious problems as two cyclones, one in March 1931 and a second in April 1932, left certain seedling areas in such a tangled mass as to make selection work extremely difficult. Such a problem, although it can be expected in this region, cannot be provided against and the attempt must be made to profit from the occasion by selecting wind resistant types from amongst the survivors. The following summary shows the progress made during the past 3 seasons. It will be seen that the number of seedlings produced in 1932 was double that obtained in 1931 while at the same time the number of uncontrolled crosses was reduced enormously.

TABLE I

Summary of crosses made and seedlings produced 1930 to 1932.

	Crossing Season		
	1930	1931	1932
No. of controlled crosses made including selfings	409	355	457
No. of uncontrolled crosses	569	370	46
No. of seedlings produced	52,840*	72,888†	157,948‡
No. of seedlings potted out for planting ...	20,108	29,263	35,863
No. of first year seedlings distributed to estates for planting	3,000	5,000	16,040
No. of 1930 seedlings retained for further trial after first season	213 = 1%	...	...

* Including 9,593 from uncontrolled crosses and 1,655 from Javan fuzz.
† „ 2,091 „ „ 12 „ Hawaiian
‡ „ 2,168 „ „ 150 „ „

All available breeding material was used during the year but those parents found to be the most prolific in the past were concentrated upon. The following parents among others were available for the first time :— BH.10 (12), P.O.J. 2725 and " Gros Genoux. " A complete list of all crosses attempted in 1932 is given below on page 20.

With regard to the Gumming Resistance Trials, mentioned above, these have now been introduced as it is felt that no seedling, however perfect when judged by ordinary standards, should be retained after its second season unless highly resistant to Gummosis. Fortunately Gum-resistance in seedlings can be tested at an early stage by using the method devised by D.S. North of Queensland, and as from the 1932 season at least three cuttings of all first year selections made will be handed over to the Mycologist for testing in Gum-Resistance Trials. Seedlings of certain crosses tested up to date have shown a degree of resistance to Gummosis approaching immunity while others are equally susceptible. These resistance trials will be conducted at the same time as the selected seedlings are undergoing their first yield trials in Latin Squares.

As it is thought that resistance or tolerance to insect attack might be measured by similar methods, attempts will be made to devise a method for testing the resistance of seedlings to Phytalus, our most serious insect pest.

TYPES OF CROSSES MADE.

A considerably increased number of crosses of the Nobilised Glagah type were made in 1932 in an attempt to obtain seedlings possessing great hybrid vigour. Below will be found a summary showing the types of crosses made during the season. It will be seen that an attempt was made to produce a considerable number of Fourth Nobilised Glagah seedlings as the writer believes that success lies largely in the exploitation of this type.

The progress made with interspecific crosses has been satisfactory as regards those crosses with Saccharum Spontaneum but the intergeneric crosses with Andropogon sorghum could not be attempted again this year owing to the very early flowering of the sorghum varieties.

Crosses between noble canes and *Saccharum munja*, Roxb, were attempted for the first time, this being the first season since the opening of the Station when this species of Saccharum has shed pollen. This pollen appeared perfect under the microscope but gave a small percentage germination in vitro. There are however very strong reasons to suppose that some of the seedlings produced are actually interspecific hybrids and not selfs.

An unsuccessful attempt was made to cross Vetiveria zizanioides (Nash) with the Noble cane.

TABLE II

TYPES OF CROSSES MADE IN 1932.

	Réduit and District	Pamplemousses and District	Total
Interspecific :—			
Glagah × Noble	1	2	3
1st Nobilised Glagah × Noble ...	8	6	14
2nd „ × „ ...	1	5	6
3rd „ × „ ...	72	61	133
4th „ × „ ...	...	3	3
Noble with Chunnee types ...	27	2	29
„ Sinense „ ...	26	11	37
Saccharum Munja × Noble ...	3	1	4
Intergeneric :—			
Noble × Vetiver	...	1	1
Noble Crosses :—	130	48	178
Other Combinations :—	31	6	37
Total ...	299	146	445

CROSSING TECHNIQUE.

A problem which caused considerable concern at the beginning of the season was the low viability in vitro of the pollen from the "male" varieties normally used in crossing. This low viability fortunately was not borne out by the number of seedlings subsequently produced, and consequently unless a better relationship can be obtained between germination of pollen in vitro and the number of seedlings produced, routine germination tests of pollen in the laboratory will be discontinued.

Crossing methods were little altered since last year. Almost all female inflorescences were crossed in situ in the field while cut arrows in SO_2 solution were used as males. No further attempt was made to produce seedlings from female inflorescences preserved in SO_2 solution during crossing as it is felt that this method is too artificial to result in good seedlings. The case of male inflorescences kept in this preservative is rather different as the nutrition factor does not enter into the problem to such an extent. The new Hawaiian solution consisting of 0.01% SO_2, 0.005% H_3PO_4 and 0.005% H_2SO_4 was tested as a preservative for male inflorescences with varying results. The normal preservative used for male arrows consists of a solution of 0.03% SO_2 and it has been found that, by removing an internode on every second day and by severing these under the solution, male arrows of most varieties can be kept in an active pollen shedding condition for 7 to 10 days but not longer. During the search for a better preservative Dr. Evans did some interesting work in connection with the blocking action of oxidase and peroxidase on the vessels of cut canes. The work is described in Part II of this report.

A comparison of the different methods* used for crossing during the year is given below, all the methods used have their own particular merit but the cage method while theoretically sound is unsuccessful chiefly owing to the fact that no reliable method has yet been found for rooting the female arrows before transferring to the cages.

* Described in previous reports.

TABLE III.

A COMPARISON OF THE CROSSING METHODS* USED IN 1932.

Types of Cross	No. of seedlings obtained at			
	Réduit		Pamplemousses	
	Per Cross	Total	Per Cross	Total
By Cage Method	11	88	0	0
,, Lantern Method ...	147	3,833	744	23,817
,, Bagging Method ...	356	23,849	365	15,684
,, Shield Method	230	2,163	524	24,654
,, Open Method	290	57,012	356	4,269

MOST PROLIFIC PARENTS.

An analysis of all crosses made in 1932 shows that the best parents in order of merit, judged by the number of seedlings produced per cross, were :—

Females : —at Réduit and District : M. 12/16, R.P. 6, 55. P, M. 20/16, P. O. J. 2878, M. 109/26 and P. O. J. 2725.

,, at Pamplemousses :— M. 109/26, P. O. J. 2878, M. 33/19, 55. P, R. P. 6, M. 55/74 and M. 55/26.

Males :—at Réduit and District : 87. P, Uba Marot, M. 17/22, Co. 213, M. 35/17, D. K. 74 and M. 19/16.

,, at Pamplemousses :— 87. P, Uba Marot, D. 109 (white), P. O. J. 2878, Senneville, D. K. 74 and M. 13/18.

MALE AND FEMALE VARIETY PLOTS.

As the result of our experience during the past three seasons it has now been found possible to lay down special breeding plots at Réduit and Pamplemousses in which all the most useful female varieties are concentrated. Similar male variety plots have also been laid down as a source of cut arrows. These plots will prevent the waste of time occasioned when breeding material is widely scattered as in the past.

SEEDLING TECHNIQUE.

This was little changed from that described in the two previous annual reports excepting that greater efforts were made to have all seedlings transplanted into the field before the end of December in order to allow selection twelve months later, thus saving approximately 6 to 10 months in the case of those seedlings planted in the uplands. To achieve this, seedlings at Réduit were raised in greenhouses during their

* Excluding 46 uncontrolled pollinations which produced 2,163 seedlings.

early stages while later, during the pot stage, liberal applications of sulphate of ammonia were given and the seedlings protected from strong winds by cheese cloth wind-screens. For the sake of economy a considerable greater number of cane leaf "pots" were used this season instead of the earthenware variety. These leaf pots have a capacity of approximately one litre and can be made for one cent of a rupee each.

As mentioned in the last report, seedlings transplanted direct from their boxes into nursery beds as an experiment were found to thrive better than those transplanted into pots in the ordinary way. As a result a trial was laid down at Réduit to test the feasibility of planting direct into the field from boxes. One hundred and seventy seedlings representing nine crosses were used for the experiment which was planted in the ordinary manner, excepting that shade was provided after planting and the seedlings more carefully nursed than usual. The results judged by the growth shown after twelve months were very satisfactory but were obtained at the expense of excessive hand watering and much recruiting in the early stages. It has been decided that the method could not be used as routine practice at Réduit but, at Pamplemousses where ample irrigation water is available, this method will be given a further trial.

FIRST YEAR SEEDLINGS PLANTED OUT.

Approximately 160,000 new seedlings were raised in 1932 of which 36,000 were potted out for planting on our experimental stations. The demand from estates for first year seedlings increased considerably during the year and sixteen thousand seedlings over and above our own requirements were distributed in this way, the only conditions attaching to the distribution being, that the Station should be allowed to carry out selection work at the end of the first season and claim half the canes in any stool selected, "M" numbers being given to these selections in the usual way. It is hoped to develop this branch of our activities considerably in order to facilitate the problem of selecting for the numerous climatic zones of the island.

SELECTIONS MADE.

The first seedlings bred by the station, in 1930, were selected in the early part of 1932. In all 204 or 1% were selected for further trial out of approximately 20,000 planted out in the field. The standard of selection was severe, no seedlings that exhibited obvious faults being retained. Selection in the first instance was based on good habit, thus eliminating about 90% of the first year population. The commonest faults observed at this stage were rind fissures and the presence of arrows, bad buds and various diseases. Further selection was carried out immediately on the remaining 10% using the Refractometer Brix* and weight of each seedling as a method of elimination. No absolute limit was laid down as regards Brix or weight and seedlings were selected from amongst batches of 50 to 400 of similar type growing on

*Measured on the standing cane, using the Zeiss Hand Refractometer.

the same area, so that selection was comparative amongst limited populations only. This procedure was found necessary owing to differences between the selection dates and to the varying vigour observed amongst seedlings of even the same cross planted at the same time, but on different soil types. Selection took place at Pamplemousses after approximately twelve months growth in the field and at Réduit, in the uplands, nine to ten months later. In the case of some 10,000 seedlings, representing numerous crosses, every seedling in each batch was examined for Refractometer Brix in order to obtain, if possible, indications as to the mode of inheritance of sucrose.

BEST PARENTS

The best parents of 1930 judged by the number of selected progeny were as follows :

Female parents			*Male parents*		
		%			%
R.P. 6	96 seedlings	=47	M. 27/16	24 seedlings	=12
Ba. 11569	37 „	=18	131. P	22 „	=11
M. 23/16	14 „	= 7	D.K. 74	21 „	=10
P.O.J. 2878	9 „	= 4	Senneville	19 „	= 9
			D. 109	18 „	= 9
			M. 35/17	15 „	= 7
			Uba Marot	11 „	= 5
			M. 23/16	9 „	= 4

It will be seen that R.P. 6 and Ba. 11569 together were female parents to more than half the selected seedlings. As Ba. 11569 has been infertile since 1930 it is unlikely that it will prove a reliable female parent locally.

PROMISING SEEDLINGS

Selected seedlings of the cross P.O.J. 2878 × Uba Marot are of particular promise for certain lands owing to their very vigorous growth, early maturity, high Refractometer Brix, freedom from arrows, free trashing and immunity to Gummosis. As regards Refractometer Brix a population of 170 unselected first year seedlings of this cross established on Ebène S.E. near Réduit gave, at fourteen months old, an average Brix figure of 19·36 for the whole population with extremes as high as 24.2. This is an unexpected result to obtain from first year seedlings of a cross in which Uba Marot was male parent, as this variety, although extremely vigorous, was discarded shortly after its discovery locally some years ago on account of its extremely low sucrose content. Owing to doubts as to the true identity of Uba Marot, cytological investigations are being conducted to determine its chromosome count while at the same time some hundreds of selfs are being raised for study.

The most promising type of seedling selected up to date are those of the 4th Nobilised Glagah type. In the writer's opinion this type will yield the best local canes of the future.

TESTING METHODS.

The use of the Hand Refractometer in the field for judging the sucrose content of first year seedlings, while they are still standing, allows ten to twenty or more holes being planted in the second season's trial, an advantage that is lost if selected canes are crushed and analysed in the usual way.

This second trial is laid out in the form of a Latin Square 10 holes × 10 holes; nine new seedling selections being tested against a standard variety in each square. At the same time as the Latin Square trials are laid down, three or more cuttings of every first year selection are handed over to the Mycologist for testing in the Gummosis Resistance Trials mentioned above. If planting material allows, duplicate Latin Square trials are laid down so that each outstanding first year selection is tested simultaneously, in its second season, at Pamplemousses in the lowlands, and at Réduit in the cooler and damper uplands. At the time of writing 39 of these Latin Square trials were in operation.

After the Latin Square trial in its second season those seedlings which are not eliminated are put into row trials, the layout being as follows. Six new varieties, five rows of each, are tested against a standard variety, every alternate row of 30 holes being a standard, thus:—Border Row, S, A, S, B, S, C, S, D, S, E, S, F, S, A, S, B, S, C, S, D, etc*. The factor limiting the size of this 3rd trial is the number of cuttings available from the previous Latin Square trial, but where possible five rows of 30 holes of each variety are planted. Up to date 22 row trials of this type have been laid down and all have worked satisfactorily excepting where very vigorous seedlings are included in the trial, in which case the standards often behave in a most erratic manner, due to the overshading effect of the more vigorous seedlings. Six feet spacing between the cane rows instead of the normal 4½ or 5 feet is being tested to overcome this difficulty. After the virgin or plant crop these row trials are allowed to go into ratoons for one or more seasons to test the ratooning powers of the new varieties.

In a recent multiplication experiment conducted by the Station and described below, it was found that the weight of crop produced from single-eye cuttings was approximately the same as that produced from tops. If this result is confirmed planting material should no longer be a limiting factor in yield trials with new seedlings—a great boon to the cane breeder.

The results of all variety yield trials harvested in 1932 are summarised below (pages 14 to 17).

MULTIPLICATION AND DISTRIBUTION OF VARIETIES.

It has now been decided that the multiplication and distribution of approved varieties released by the Station will be carried out by the Agricultural Division of the Department of Agriculture, this Station confining its activities as far as possible to research work.

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* Plan shown in First Annual Report.

VARIETY COLLECTIONS.

With a view to their preservation as breeding material, and as a subject for study, a collection of almost all known varieties found in Mauritius has been established at Réduit. This collection comprises 128 varieties including sports and certain Mauritius seedling varieties of value. A similar collection will be established at Pamplemousses Experiment Station next season. It is unfortunate that so many varieties have been lost to Mauritius including, so far as is known, all those produced by Bonâme between 1895 and 1913.

VARIETY YIELD TRIAL RESULTS

The number of variety yield trials was increased to nineteen during the year. The results from the eleven trials harvested in 1932 are given below. It is particularly important that this year's results in ratoons should be compared with those of the virgins of last year.

TABLE IV

Trial No. 1, St. Aubin S.E.

(1st ratoons, cut on 26th October 1932)

Average yield of 67 standard plots of W. Tanna = 4.45 tons sucrose (per acre

Average difference of	11	plots of	B.H. 10 (12)	=	$+0.65 \pm 0.21$	„
„ „	11	„	R.P. 6	=	$+0.49 \pm 0.21$	„
„ „	11	„	R.P. 8	=	$+1.42 \pm 0.21$	„
„ „	11	„	M. 23/16	=	$+1.51 \pm 0.21$	„
„ „	11	„	M. 27/16	=	-0.15 ± 0.21	„
„ „	11	„	M. 12/21	=	-1.18 ± 0.21	„

Conclusions.—M. 23/16, R.P. 8, B.H. 10 (12) and R.P. 6 were all significantly better than White Tanna. M. 12/21 was significantly worse. Last year in virgins M. 23/16 and M. 27/16 were significantly better and M. 12/21 significantly worse than White Tanna.

TABLE V

Trial No. 2, St. Aubin S.E.

(1st ratoons, cut on 24th October 1932).

Average yield of 31 standard plots of W. Tanna = 4.05 tons sucrose (per acre

Average difference of	5	plots of	M. 27/16	=	$+0.60 \pm 0.32$	„
„ „	5	„	M. 13/18	=	$+1.32 \pm 0.32$	„
„ „	5	„	M. 17/18	=	-0.71 ± 0.32	„
„ „	5	„	M. 33/19	=	-0.60 ± 0.32	„
„ „	5	„	M. 15/20	=	-0.30 ± 0.32	„
„ „	5	„	M. 26/20	=	$+0.18 \pm 0.32$	„

Conclusions.—M. 13/18 was significantly better than all the other varieties thus confirming last year's results in virgins.

TABLE VI

Trial No. 3, St. Aubin S.E.

(1st ratoons, cut on 29th October 1932).

Average yield of 31 standard plots of W. Tanna = 4.44 tons sucrose per acre

Average difference of	5	plots of	M. 12/21	=	+0.63±0.46	,,
,, ,,	5	,,	M. 5/22	=	−0.99±0.46	,,
,, ,,	5	,,	M. 7/23	=	+0.78±0.46	,,
,, ,,	5	,,	M. 10/25	=	+0.71±0.46	,,
,, ,,	5	,,	M. 14/26	=	+0.12±0.46	,,
,, ,,	5	,,	M.109/26	=	+0.16±0.46	,,

Conclusions.—None of the varieties were significantly better or worse than White Tanna excepting M. 5/22 which was significantly worse. Last year in virgins all the varieties tested were significantly better than White Tanna.

TABLE VII

Trial No. 4, Union (Ducray) S.E.

(1st ratoons, cut on 3rd November 1932).

Average yield of 26 standard plots of W. Tanna = 2.73 tons sucrose per acre.

Average difference of	5	plots of	M. 1/17	=	+2.02±0.15	,,
,, ,,	5	,,	M. 5/22	=	+1.87±0.15	,,
,, ,,	5	,,	M. 7/23	=	+2.54±0.15	,,
,, ,,	5	,,	M. 10/25	=	+1.86±0.15	,,
,, ,,	5	,,	M. 12/21	=	+3.01±0.15	,,

Conclusions.—All the varieties were significantly better than White Tanna, M. 12/21 being the best. Last year all were better than White Tanna, M. 5/22 and M. 10/25 being best.

TABLE VIII.

Trial No. 5, Union (Ducray) S.E.

(1st ratoons, cut on 4th November, 1932)

Average yield of 26 standard plots of W. Tanna = 2.93 tons sucrose per acre.

,, difference of	5	plots of	M. 27/16	=	+3.28±0.18	,,
,, ,,	5	,,	M. 29/16	=	+1.61±0.18	,,
,, ,,	5	,,	M. 34/22	=	+1.72±0.18	,,
,, ,,	5	,,	M. 57/26	=	+0.34±0.18	,,
,, ,,	5	,,	B H. 10(12)	=	+1.86±0.18	,,

Conclusions :—All varieties were significantly better than White Tanna, M. 27/16 and B H. 10(12) being the best thus confirming last year's results in virgins.

TABLE IX.

Trial No. 6, Mon Rocher S.E.

(1st ratoons, cut 22nd October 1932.)

Average yield of 5 standard plots of W. Tanna = 3.39 tons sucrose per acre.

„ difference of 4 plots of P. O. J. 2878 = +3.21±0.47 „

Conclusions.—P. O. J. 2878 was significantly better than the standard yielding almost twice as much as White Tanna. This confirms results of last year in virgins when however the yields of both varieties were considerably lower.

TABLE X.

Trial No. 7, Mon Rocher S.E.

(1st ratoons, cut on 28th November 1932)

Average yield of 31 standard plots of D. 109 = 5.26 tons sucrose per acre.

„	difference of	5	plots of	M. 27/16	=	−0.48±0.27 „
„	„	5	„	M. 13/18	=	+0.47±0.27 „
„	„	5	„	M. 17/18	=	−1.20±0.27 „
„	„	5	„	M. 33/19	=	−1.20±0.27 „
„	„	5	„	M. 15/20	=	−0.38±0.27 „
„	„	5	„	M. 26/20	=	+0.52±0.27 „

Conclusions.—M. 26/20 was significantly better than D. 109, M.17/18 and M. 33/19 being significantly worse. M. 13/18 was also better than D. 109 but not significantly so. Last year in virgins all the varieties were significantly worse than the standard D. 109.

TABLE XI.

Trial No. 8, Mon Rocher S.E.

(1st ratoons, cut on 30th November 1932)

Average yield of 31 standand plots of BH. 10 (12) = 5.12 tons sucrose per acre.

„	difference of	5	plots of	M. 12/21	=	−1.44±0.42 „
„	„	5	„	M. 5/22	=	−0.83±0.42 „
„	„	5	„	M. 7/23	=	+0.23±0.42 „
„	„	5	„	M. 10/25	=	−1.47±0.42 „
„	„	5	„	M. 14/26	=	−0.31±0.42 „
„	„	5	„	M 109/26	=	+1.86±0.42 „

Conclusions —M. 109/26 was significantly better than BH. 10 (12) the standard, while M 12/21, M. 5/22 and M. 10/25 were significantly inferior. Last year in virgins, M. 14/26 was significantly better than BH. 10 (12) while M. 12/21 and M. 10/25 were significantly worse.

TABLE XII

Trial No. 10 Beau Champ S.E.

(Virgins planted October 1930, cut 22nd August 1932)

Average yield of 31 standard plots of W. Tanna = 2.25 tons sucrose per acre.

„	difference of	5	plots of	BH. 10 (12)	=	+3.38±0.26 „
„	„	5	„	M. 27/16	=	+3.68±0.26 „
„	„	5	„	M. 13/18	=	+2.68±0.26 „
„	„	5	„	M. 5/22	=	+1.03±0.26 „
„	„	5	„	M. 15/16	=	+1.08±0.26 „
„	„	5	„	M. 29/16	=	+3.57±0.26 „

Conclusions.—All varieties yielded significantly better crops than White Tanna, M. 27/16, M. 29/16, B.H. 10 (12) and M. 13/18 being the best.

TABLE XIII

Trial No. 11, Beau Champ S.E.

(Virgins planted October 1930, cut 22nd August 1932.)

Average yield of 31 standard plots of W. Tanna = 2.44 tons sucrose per acre.

„	difference of	5	plots of	M. 35/17	=	+1.93±0.34 „
„	„	5	„	M. 23/16	=	+3.27±0.34 „
„	„	5	„	M. 12/21	=	+0.86±0.34 „
„	„	5	„	M. 19/17	=	−0.42±0.34 „
„	„	5	„	M. 108/26	=	−1.24±0.34 „
„	„	5	„	M. 9/18	=	−0.44±0.34 „

Conclusions.— M. 23/16, M. 35/17, and M. 12/21 yieled significantly better crops than White Tanna, M. 108/26 being significantly worse.

TABLE XIV

Trial No. 16, Mon Rocher S.E.

(Virgins planted 18th September 1931, cut 2nd December 1932)

Average yield of 25 standard plots of BH. 10 (12) = 5.36 tons sucrose per acre.

„	difference of	8	plots of	P.O.J. 2878	=	−1.97±0.44 „
„	„	8	„	P. O. J. 2725	=	−1.62±0.44 „
„	„	8	„	M. 23/16	=	−1.28±0.44 „

Conclusions.— P. O. J. 2878, P. O. J. 2725 and M. 23/16 were significantly worse than BH. 10 (12), the standard.

RECOMMENDATIONS.

The following varieties are recommended as a result of the yield trials conducted by the Station during the past two years :— M. 23/16, M. 13/18, M. 27/16 and BH. 10 (12). The variety P. O. J. 2878 it will be seen gave excellent results in virgins and ratoons in Trial No. 6 but

in Trial No. 16 was inferior to BH. 10 (12), the standard in the experiment. It will be possible to report more definitely on the behaviour of this cane after recording the results of the eight experiments in which this cane is being tested throughout the island in 1933. The varieties M. 12/21 and M. 5/22, although excellent in some experiments were erratic and so cannot yet be recommended for general planting. The following Mauritius seedlings, having given good results in at least one experiment, are recommended for further trial :— M. 109/26, M. 14/26, M. 7/23, M. 26/20, M. 35/17, M. 17/18 and M. 34/22.

NEWLY IMPORTED VARIETIES.

The following imported varieties released from quarantine last year are being put into yield trials as soon as possible : —Se. 12 (4), P. O. J. 2940, P. O. J. 2747, D. I. 52, S. W. 499 and Selangor Seedling.

OTHER INVESTIGATIONS.

Growth Rate Experiments with Sugarcane.—In 1930 with a view to undertaking a detailed study of the relative influence of the various factors affecting cane-growth, the writer established growth rate experiments at Réduit and Pamplemousses using the varieties White Tanna and P. O. J. 2878. In these experiments, which extended over two years, the weekly growth rate, for virgins and ratoons, was measured in the case of every cane in five stools of both varieties at each centre, while at the same time the following factors were recorded : rainfall, soil moisture, temperature, sunshine, wind velocity and humidity (as measured by Livingstone atmometers). These growth-rate measurements have now been analysed in detail by the Physiological Botanist who has now taken over these studies. The results of this analysis which are given briefly in Part II of the report can be summarised here as follows :—

1. That the period of maximum cane-growth corresponds with the period January to April, the times of maximum, minimum and intermediate growth coinciding at Réduit and Pamplemousses, in the season 1930–31.

2. That a significant correlation exists between growth rate, soil moisture, temperature and relative dryness of the atmosphere.

3. That there is a correlation between the growth-rate of both varieties.

4. That the net amount of damage done by cane-borers in 1931 was greater than the damage done by the severe cyclone of March 1931 when approximately 28% of the canes in the experiment were destroyed.

Rapid Multiplication Experiment.—With a view to determining how quickly a new cane variety could be multiplied, an experiment was laid down in 1930 to determine what rate of multiplication could be obtained from a cane seedling, using the method of planting every aërial bud in the stool. One stool of each of two seedling varieties were used for the experiment, and after the removal of the " tops ", which were planted as controls, the remaining canes were cut up into single-eye cuttings and planted. The results obtai ed from this experiment,

which are given in tabular form below, are exceedingly interesting showing :—

(*i*) That the return obtained from single-eye cuttings of both varieties was the same or 100–fold approximately.

(*ii*) That the return from the single-eye cuttings was proportional to the weight planted.

(*iii*) That the yield from single-eye cuttings was approximately the same as from "tops". This is important information for the cane breeder who must lay down yield trials of new varieties with very limited planting material.

RAPID MULTIPLICATION EXPERIMENT, RESULTS

	Variety	
	M. 5/22	M. 1/17
1. Weight of original stool ...	12.78 kgs	24.50 kgs
2. Number of canes in stool ...	10	10
3. Weight of "tops" cut from stool (the controls)	3.50 kgs	4.50 kgs
4. Average weight of each "top" ...	350 grs	450 grs
5. Total weight of body-canes left ...	9.28 kgs	20.00 kgs
6. Number of single-eye cuttings produced from above	122	153
7. Average weight of each single eye cutting	76 grs	131 grs
8. Percentage germination of "tops" in nursery	100%	100%
9. Percentage germination of single-eye cuttings in nursery	62.3%	85.6%
10. Percentage of "tops" that died in field	none	none
11. Percentage of single-eye cuttings that died in field	34.2%	2.3%
12. Number of stools, produced from "tops" standing at harvest ...	10	10
13. Number of stools, produced from single-eye cuttings, standing at harvest	50	128
14. Total weight of cane from stools produced from "tops" (controls) ...	453.5 kgs: 67.5 kgs	1846 kgs: 143.5 kgs
15. Total weight of canes from stools produced from single-eye cuttings ...	453.5 kgs: 386 „	1846 kgs: 1702.5 „
16. Average weight of stools produced from "tops"	6.75 kgs	14.35 kgs
17. Average weight of surviving stools produced from single-eye cuttings ...	7.72 „	13.30 „
18. Growing period of above crop	Nov/1930 to Sept/1932	Nov/1930 to Sept/1932
19. Calculated crop that could be produced from 14 and 15 above in the same time assuming same rate of multiplication as in this experiment ...	16,100 kgs	139,188 kgs

Mutations.—In 1930, following on the discovery of 32 coloured sports amongst a population of 27,700 stools representing 207 varieties, a search was made for giant sports in the hope of exploiting the phenomenon. Five supposed giant sports were discovered in 1930-31 and cuttings of these interplanted between controls. When examined in 1932 the canes of the stools grown from the supposed sports proved normal and in no way larger in size than those of the parent clones.

X—Ray Experiments.—In the Annual Report of the Station for 1930 a paragraph is devoted to the X—Ray experiments started with the main object of producing mutations in sugarcane seedlings after the manner of Goodspeed, Olsen, Stadler and others working with other crops. These X—Ray studies have perforce been discontinued owing to the amount of time that must now be devoted to the ordinary routine duties of plant breeding and selecting.

Réduit,
January 1933.

A. GLENDON HILL,
Senior Geneticist,
i/c Sugarcane Research Station.

TABLE XV

List of Crosses made during season 1932.

1.—CROSSES BETWEEN "NOBLE CANES"

Combination	Location of cross	No. of crosses made	No. of seedlings obtained	No. of seedlings potted at:—	
				C. E. S.	P. E. S.
55. P. x M. 35/17 ...	Béga ...	1	750	128	...
„ x M. 12/21 ...	„ ...	2	746	200	156
„ x D.K. 74 ...	„ ..	1	3,310	250	...
„ x „ ..	Ebène ...	3	715	365	...
„ x „ ...	P.E.S. ...	1	2,000	...	100
„ x D.109 White Sport ...	„ ...	1	1,158	...	50
131. P. x M. 35/17 ...	Béga ...	2	258	196	...
„ x M. 17/24 ...	„ ...	1	262	200	...
„ x D. K. 74 ...	„ ..	1	39	14	...
M. 55/74 x „ ...	Mon Rocher ...	2	392	...	177
„ x „ ..	C.E.S. ...	1	14	12	...
„ x Senneville	Mon Rocher ...	1	300	...	137
M. 12/16 x M. 27/16 ...	Béga ...	1	1,258	250	...
„ x M. 35/17 ..	„ ..	1	188	116	...
„ x D.K. 71 ...	„ ...	2	1,263	205	280
	Carried over ...	21	12,653	1,936	900

1.—CROSSES BETWEEN "NOBLE CANES"—(*Continued*)

Combination	Location of cross	No. of crosses made	No. of seedlings obtained	No. of seedlings potted at :—	
				C. E. S.	P. E. S.
	Brought forward	21	12,653	1,936	900
M. 15/16 x D. 109 ...	C.E.S. ...	1	4	4	..
M. 20/16 x 87. P.	Béga ..	1	600	200	200
,, x M. 23/16 ...	,, ...	2	550	267	...
,, x M. 24/12 ...	,, ...	1	20	13	...
,, x M. 27/16 ...	,, ...	1	350	110	...
,, x M. 35/17 ...	,, ...	2	2,878	262	...
,, x M. 50/19 ...	Mon Rocher ...	2	146	...	81
,, x M. 12/21 ...	Béga ...	1	1,445	265	...
,, x M. 113/26...	C.E.S. ...	1	200	183	...
,, x D.K. 74 ...	Béga ...	3	2,480	475	...
,, x ,, ...	C.E.S. ...	2	463	8	...
,, x D.K. 74/70..	,, ...	1	0	0	...
M. 23/16 x M. 19/16 ...	Béga ...	1	27	24	...
,, x M. 27/16 ...	,, ..	3	96	92	...
,, x M. 35/17 ...	,, ...	2	112	68	...
,, x D.K. 74 ...	,, ...	2	176	176	...
,, x ,, ...	C.E.S. ...	1	14	10	...
M. 24/16 x M. 27/16 ...	Béga ...	2	32	26	...
M. 1/17 x 55. P. ...	,, ...	1	0	0	..
,, x 87 P. ...	,, ...	2	207	186	...
,, x M. 19/16 ...	,, ...	2	113	107	...
,, x M. 27/16 ...	,, ...	3	7	5	...
,, x ,, ...	C.E S. ...	1	0	...	...
,, x M. 35/17 ...	Béga ..	2	750	437	...
,, x Senneville ..	,, ...	1	926	125	...
,, x M. 17/24 ...	,, ...	1	2,080	155	200
,, x D.K. 74 ...	,, ..	2	836	257	...
M. 7/17 x ,, ...	Mon Rocher ...	1	135	...	134
,, x ,, ...	P.E.S. ...	1	800	...	50
M. 17/18 x M. 23/16 ...	,, ...	1	8	...	7
M. 33/19 x D.109 White Sport ...	,, ...	1	1,675	...	...
,, x 55. P. ...	,, ...	1	60	...	21
,, x 87. P. ...	,, ...	1	800	...	...
,, x 131. P ...	,, ...	1	40	...	29
,, x M. 23/16 ...	,, ...	2	171	...	83
,, x M. 27/16 ...	C.E.S. ...	2	5	5	...
,, x M. 35/17 ...	,, ...	1	457	150	...
,, x M. 13/18 ...	P.E.S ..	1	732	...	400
,, x ,, ...	C.E.S. ...	2	71	69	...
,, x M. 5/19 ...	,, ...	2	71	58	...
,, x M. 50/19 ...	P.E.S. ...	1	87	...	61
	Carried over ...	83	32,277	5,673	2,166

1.—CROSSES BETWEEN NOBLE CANES—(*Continued*)

Combination	Location of cross	No. of crosses made	No. of seedlings obtained	No. of seedlings potted at :— C. E. S.	No. of seedlings potted at :— P. E. S.
	Brought forward	83	32,277	5,673	2,166
M. 33/19 x M. 12/21 ...	C.E.S. ..	1	1	1	...
„ x M. 24/25 ...	P.E.S. ...	1	113	...	55
„ x M. 49/27 ...	„ ...	3	276	...	216
„ x Senneville ..	„ ...	7	1,842	...	344
„ x D.K 74 ...	C.E.S. ...	2	16	14	...
M. 26/20 x M. 27/16 ...	„ ...	1	11	10	...
„ x D. K. 74 ...	„ ...	2	226	193	...
„ x D.109, White Sport ..	P.E.S. ...	1	660	...	...
M. 10/21 x D.K. 74 ...	C.E.S. ...	1	250	209	...
„ x D. 109 ...	„ ...	1	160	145	...
M 6/22 x Senneville ..	P.E.S. ...	1	2,296	...	100
M. 10/22 x M. 35/17 ...	Ebène ...	1	467	195	...
„ x M. 13/18 ...	„ ...	1	40	29	...
„ x D. K. 74 ...	„ ...	1	14	12	...
M. 15/24 x M 23/16 ...	P.E.S. ..	1	...	...	...
M. 109/26 x D. 109 ...	Mon Rocher ...	1	2,200	...	...
„ x D. K. 74 ...	P.E.S. ...	1	574	...	...
„ x „ ...	C.E.S. ...	1	600	300	139
„ x 87. P. ...	Mon Rocher ...	1	2,496	...	389
„ x M. 13/18 ..	C.E.S. ...	1	452	160	...
„ x „ ...	P.E.S. ...	1	3,100	...	...
„ x M 5/19 ...	„ ..	1	2,000	...	...
M. 158/26 x D. 109 ...	„ ...	1	400	...	62
Bambou Rayée (White Sport) x D K. 74	C.E.S. ...	4	165	149	...
B. 3390 x M. 24/16 ...	Ebène ...	1	0	0	...
„ x M. 27/16 ...	„ ...	2	2	2	...
„ x M 29/16 ...	„ ...	1	1	1	...
„ x M. 35/17 ...	„ ...	1	1	0	...
„ x M. 13/18 ...	„ ...	1	4	0	...
„ x D. K. 74 ...	„ ...	1	7	7	...
Ba. 11569 x M. 23/16 ...	„ ...	1	0	...	...
„ x „ ...	Mon Rocher ...	1	350	...	...
„ x M. 27/16 ...	Ebène ...	1	24	20	...
„ x M. 13/18 ...	„ ...	1	4	4	...
BH. 10(12) x D.K. 74 ...	California S.E...	1	27	..	24
„ x 55. P. ...	„ ...	1	...	...	...
H. 109 x D.109, White Sport ...	Mon Rocher ...	1	2,300	...	211
	Carried over ...	134	53,356	7,124	3,727

1.—CROSSES BETWEEN "NOBLE CANES"—*(Continued)*

Combination	Location of cross	No. of crosses made	No. of seedlings obtained	No. of seedlings potted at :—	
				C. E. S.	P. E. S.
	Brought forward	134	53,356	7,124	3,727
R. P. 6 x 87. P. ...	Béga ...	3	1,415	736	150
„ x M. 19/16 ...	„ ...	2	1,856	515	...
„ x M. 23/16 ...	„ ...	3	79	73	...
„ x M. 24/16 ...	„ ...	2	450	308	...
„ x M. 27/16 ...	„ ...	7	7,139	1,097	...
„ x „ ...	C.E.S. ...	2	225	150	...
„ x „ ...	Maison Blanche..	1	700	...	100
„ x M. 35/17...	„ ...	1	908	...	350
„ x „ ...	Béga ...	1	1,000	69	...
„ x M. 12/21...	„ ...	2	452	303	..
„ x M. 113/26...	C.E.S. ...	1	78	73	...
„ x M. 49/27 ...	Maison Blanche..	1	148	...	78
„ x D. 109 ...	„ ...	1	83	...	45
„ x D.109 White Sport ...	„ ...	1	173	...	97
„ x D.K. 74 ...	„ ...	1	324	...	100
„ x „ ...	Béga ...	4	7,230	560	550
„ x Senneville ..	„ ...	1	250	208	...
„ x B.H. 10 (12)	„ ...	1	425	250	...
TannaMon Desert, x M. 27/16	C.E.S. ...	2	0	...	...
„ x „ ...	Trianon ...	3	2	1	...
„ x M. 12/21...	„ ...	1	0	...	...
„ x D.K. 74 ...	„ ...	2	0	...	...
„ x „ ...	C.E.S. ...	1	0	...	...
	Total ...	178	76,293	11,467	5,197

2.—INTER-SPECIFIC CROSSES.

I.—1st Nobilised Glagah					
M. 55/74 x Glagah Tabango	P.E.S. ...	1	148	...	142
„ x Glagah Kletak	C.E.S. ...	1	19	19	...
„ x „ ...	P.E.S. ...	1	115	...	98
	Total ...	3	282	19	240

2.—INTER-SPECIFIC CROSSES—(*Continued*)

Combination	Location of cross	No. of crosses made	No. of seedlings obtained	No. of seedlings potted at :—	
				C. E. S.	P. E. S.
II.—2ND NOBILISED GLAGAH					
55. P x Seedling 740/30	P.E.S. ...	1	10	...	5
131. P x Seedling 243/31	Béga ..	1	0	...	...
M. 20/16 x 1st Nobilised Glagah	,, ..	1	150	125	...
M. 1/17 x do	,, ...	1	0	...	...
,, x Seedling 522/31	,, ...	2	230	207	...
M. 33/19 x do	C.E.S. ...	1	1,788	200	...
,, x Seedling 1012/30	P.E.S. ...	1	1,800	...	310
M. 55/26 x Seedling 702/30	,, ...	1	75	...	65
,, x Seedling 735/30	,, ...	1	300	...	246
R. P. 6 x 1st Nobilised Glagah	Béga ...	1	183	161	...
Mapou Perlée x Seedling 1012/30	P.E.S. ...	1	...	...	...
Seedling No. 5682/20 x Seedling 180/30	,, ...	1	209	...	103
Kassoer x D. K. 74 ...	C.E.S. ...	1	4	2	..
	Total ...	14	4,749	695	729
III.—3RD NOBILISED GLAGAH					
Seedling 1533/31 x D.K. 74 ...	C.E.S. ...	1	0	—	...
M. 33/19 x Seedling 4961/30 ...	P.E.S. ...	1	...	...	...
M. 15/24 x do ...	Mon Rocher ...	1	...	...	...
M. 55/26 x do ...	P.E.S. ...	1	10	...	8
M. 109/26 x Seedling 4968/30 ...	,, ...	1	300	...	...
Mapou Perlée x do	,, ...	1	43	...	30
	Total ...	6	353	0	38

2.—INTER-SPECIFIC CROSSES—(*Continued*)

Combination	Location of cross	No. of crosses made	No. of seedlings obtained	No. of seedlings potted at :— C.E.S.	No. of seedlings potted at :— P.E.S.
IV.—4TH NOBILISED GLAGAH					
55. P. x P.O.J. 2878.	Ebène S.E. ...	2	45	35	...
„ x „ ...	P.E.S. ...	1	249	...	206
M. 55/74 x „ ...	„ ...	2	53	...	38
„ x „ ...	C.E.S. ...	2	0	...	...
M. 20/16 x „ ...	Mon Rocher S.E.	1	54	...	44
M. 33/19 x „ ...	P.E.S. ...	5	2,216	...	670
„ x „ ...	C.E.S. ...	7	256	250	...
M. 6/22 x „ ...	P.E.S. ...	1	12	...	9
M. 109/26x „ ...	„ ...	2	3,852	...	78
„ x „ ..	C.E.S. ...	1	55	54	...
Ba. 11569x „ ..	Ebène S.E. ...	2	3	3	...
„ x „ ...	Mon Rocher S.E.	1	4	...	2
H. 109 x „ ...	„ ...	1	15	...	10
R.P. 6 x „ ...	Ebène S.E. ...	7	1,112	760	...
„ x „ ...	Maison Blanche.	1	71	...	54
Tanna Mon Désert x „ ...	Trianon S.E. ...	1	0	...	...
„ x „ ...	C.E.S. ...	1	0	..	...
P.O.J. 2878 x 87. P. ...	Ebène S.E. ...	6	7,972	425	100
„ x „ ...	Mon Rocher S.E.	4	10,078	...	400
„ x 131 P. ..	„ ...	2	21	...	17
„ x M. 11/16 ...	„ ...	1	220	...	218
„ x M. 19/16 ..	Ebène S.E. ...	1	200	195	..
„ x M. 23/16 ...	C.E.S. ..	1	7	7	...
„ x „ ...	Mon Rocher S.E.	3	201	...	132
„ x M. 24/16 ...	Ebène S.E. ...	2	87	77	...
„ x M. 27/16 ...	„ ...	3	72	60	...
„ x „ ...	C.E.S. ...	8	37	37	...
„ x „ ...	Mon Rocher S.E.	2	249	...	222
„ x M 29/16 ...	„ ...	2	14	...	13
„ x „ ..	C.E.S. ...	3	17	16	...
„ x M. 35/17 ...	Ebène S.E. ...	4	1,457	512	...
„ x „ ...	C.E.S. ...	2	1,050	461	326
„ x „ ...	Mon Rocher S.E.	2	2,704	...	100
„ x M. 13/18 ...	„ ..	2	124	...	100
„ x „ ...	Ebène S.E. ...	2	56	53	...
„ x M. 2/19 ...	Mon Rocher S.E.	1	13	...	11
„ x M. 50/19 ...	„ ...	2	658	...	345
„ x M. 26/20 ...	„ ...	1	2	...	...
„ x M. 12/21 ...	Ebène S.E. ...	4	98	89	...
„ x M. 4/24 ...	Mon Rocher S.E.	1	180	...	157
	Carried over ...	97	33,514	3,034	3,252

2.—INTER-SPECIFIC CROSSES—(*Continued*)

Combination	Location of cross	No. of crosses made	No. of seedlings obtained	No. of seedlings potted at :—	
				C. E. S.	P. E. S.
	Brought forward	97	33,514	3,034	3,252
P.O.J. 2878 x M.17/24...	Ebène S.E. ...	1	175	169	...
,, x M. 5/25 ...	Mon Rocher S.E.	1	...	...	...
,, x M. 24/25 ...	,, ...	2	312	...	289
,, x M. 37/26 ...	,, ...	1	131	...	110
,, x M. 38/26 ...	,, ...	1	135	...	91
,, x M. 109/26 ...	,, ...	2	231	...	204
,, x M. 49/27 ...	,, ...	1	...	...	...
,, x Senneville ...	,, ...	4	288	...	216
,, x ,, ...	Ebène S.E. ...	2	168	150	...
,, x ,, ..	C.E.S. ...	1	1	1	...
,, x D. 109 ..	Mon Rocher S.E.	2	151	...	135
P.O.J. 2878 x D. 109 (White Sport)	Mon Rocher S.E.	2	200	...	139
,, x D.K. 74 ...	,, ...	4	326	...	233
,, x ,, ...	Ebène S.E. ...	2	62	57	...
,, x ,, ...	C.E.S. ...	3	111	60	...
,, x BH.10 (12)...	,, ...	4	25	24	...
,, x Louzier ...	Mon Rocher S.E.	1	76	...	42
,, x 86/04 ...	,, ...	1	90	...	71
,, x 55/453 ...	,, ...	1	27	...	14
	Total ...	133	36,023	3,495	4,796
V. 5TH NOBILISED GIAGAH					
M. 33/19 x Seedling 4937/30 ...	P.E.S. ...	1	1	...	...
M. 15/24 x ,, ...	Mon Rocher ...	1	4	...	3
M. 55/26 x ,, ...	P.E.S. ..	1	36	...	28
	Total ...	3	41	0	31
VI. CHUNNEE CROSSES					
131.P. x Co. 213 ...	Béga ...	4	1,740	303	...
M. 55/74 x M. 202/30 ...	C.E.S. ...	1	0	...	...
M. 55/26 x Co. 213 ...	P.E.S. ...	1	128	...	113
Bambou Rayée (White Sport) x P.O.J. 161 ...	C.E.S. ...	1	19	16	...
P.O.J. 213 x S7. P. ...	P.E.S. ...	1	166	...	124
,, x ,, ..	Béga ...	3	258	217	...
,, x M. 19/16 ...	,, ...	2	6	6	...
,, x M. 27/16 ..	,, ...	3	1	1	...
,, x M. 35/17 ..	,, ..	2	51	45	...
	Carried over ...	18	2,369	588	237

2.—INTER-SPECIFIC CROSSINGS.—(*Continued*)

Combination	Location of cross	No. of crosses made	No. of seedlings obtained	No. of seedlings potted at :— C. E. S.	P. E. S.
	Brought forward	18	2,369	588	237
P.O.J. 213 x M. 12/21 ...	Béga ...	2	8	8	...
„ x M. 17/24 ...	„ ...	5	262	228	...
„ x Senneville ...	„ ...	1	10	10	...
„ x D.K. 74 ...	„ ...	3	47	44	...
„ x „ ...	C.E.S. ...	1	9	9	...
	Total ...	30	2,705	887	237
VII. Saccharum-Sinense Crosses					
55. P. x Uba Marot ...	Béga ...	2	25	23	...
„ x „ ...	Mon Rocher ...	1	17	...	12
M. 55/74 x „ ...	„ ...	1	32	...	24
„ x „ ...	C.E.S. ...	2	51	48	...
„ x M. 6/29 ...	Mon Rocher S.E.	1	2	...	...
M. 12/16 x Uba Marot...	Béga ...	1	65	63	...
M. 15/16 x „ ...	P.E.S. ...	1	7	...	6
M. 20/16 x „ ...	Béga ...	2	532	207	...
M. 24/16 x „ ...	„ ...	2	97	8	...
M. 1/17 x „ ...	„ ...	2	163	142	...
M. 7/17 x „ ...	P.E.S. ...	2	180	...	101
M. 33/19 x „ ...	„ ...	1	...	...	...
„ x „ ...	C.E.S. ...	1	571	250	...
M. 109/26x „ ...	Mon Rocher S.E.	1	1,592	...	350
Bambou Rayée } x „ ... White Sport }	C.E.S. ...	1	205	182	...
R.P. 6 x „ ...	„ ...	1	70	62	...
„ x „ ...	Béga ...	1	137	126	...
„ x Uba Marot	Ebène S.E. ...	1	28	20	...
Gros Genoux x „	P.E.S. ...	1	75	...	46
Uba x „	C.E.S. ...	1	0	...	...
BH. 10 (12) x „	California S.E.	1	13	...	12
Tanna Mon Désert x Uba Marot ...	Trianon S.E. ...	2	1	1	...
Uba x M. 27/16 ...	C.E.S. ...	1	0	...	...
„ x D.K. 74 ...	„ ...	1	1	...	...
Uba Rayée x D.K. 74 ...	„ ...	2	1	1	...
White Uba x M. 27/16...	„ ...	1	0	...	...
„ x M. 57/26...	„ ...	2	0	...	...
Brown Sport Uba seedling x M. 50/19...	P.E.S. ...	1	80	...	65
	Total ...	37	3,945	1,205	616

2.—INTER-SPECIFIC CROSSINGS—(*Continued*)

Combination	Location of cross	No. of crosses made	No. of seedlings obtained	No. of seedlings potted at :— C. E. S.	No. of seedlings potted at :— P. E. S.
VIII.—Other Combinations					
P. O. J. 213 x Uba Marot ...	Béga ..	6	2,960	887	...
„ x „	C.E.S. ...	3	390	269	...
„ x „	P.E.S. ...	2	4,000	...	100
P. O. J. 2725 x „	Mon Rocher S.E.	1	1,047	...	450
„ x „	C.E.S. ...	1	275	240	...
P. O. J. 2878 x „	„ ...	9	4,321	788	...
„ x „	Béga ...	9	11,474	1,139	...
„ x „	Mon Rocher S.E.	3	5,225	...	1,022
Uba x P.O.J. 2878	C.E.S. ..	1	11	11	...
White Uba x „	„ ...	1	600	282	...
131. P x Saccharum Munja...	Béga ...	2	288	145	66
M. 20/16 x „ „ ...	„ ...	1	0	...	..
	Total ...	39	30,591	3,761	1,638
3.—INTER-GENERIC CROSSES					
M. 33/19 x Vetiver ...	P.E.S. ...	1	378	...	253
	Total ...	1	378	—	253

4.—SELFINGS

Variety	Location	No. of Selfings made	No. of seedlings obtained	No. of seedlings potted at C.E.S	No. of seedlings potted at P.E.S
55. P ...	Mon Rocher S.E.	1	1	...	...
M. 20/16 ...	C E.S. ...	1	0	...	..
M. 7/17 ...	Mon Rocher S.E.	1	1	...	...
M. 33/19 ...	C.E.S. ...	1	0	...	...
M. 109/26 ...	P.E.S. ...	1	315	...	...
Kassoer ...	C.E.S. ...	1	0	...	...
P. O. J. 2878 ...	C.E.S. ...	2	2	...	...
„ ...	Mon Rocher S.E.	2	0	...	...
Uba Marot ...	P.E.S. ...	1	94	...	50
„ ...	Trianon S.E. ...	2	7	4	...
	Total ...	13	420	4	50

5.—UNCONTROLLED POLLINATIONS

Variety	Location	Number made	No. of seedlings obtained	No. of seedlings potted at	
				C.E.S	P.E.S.
55. P ...	Mon Rocher S.E.	4	74	...	...
M. 55/26 ...	P.E.S. ...	1	40	...	...
P. O. J. 2878 ...	Mon Rocher S.E	3	271	...	35
do ...	Ebène S.E. ...	15	752	...	...
R. P. 6 ...	„ ..	15	10	...	...
do ...	California S.E.	6	1,021	...	159
Louzier ...	Australia S E. ...	1	...	...	...
BH. 10 (12) ..	California S.E.	1	...	...	...
	Total ...	46	2,168	0	194
	GRAND TOTAL	503	157,948	21,533	14,019

PART II

RESEARCH BOTANY

ROOT INVESTIGATIONS

The root investigations which have been commenced in the Physiological Division may be grouped under four main headings.

(1) The study of the mature root-systems of different varieties.
(2) The study of the root-system of ratoon crops.
(3) The development of the root-system from the cutting to maturity.
(4) The study of the growth of individual roots and rootlets.

1. THE STUDY OF THE MATURE ROOT-SYSTEMS OF DIFFERENT VARIETIES.—Several methods have been used for the study of the root-systems of sugar cane, the chief of these being the so-called "Direct Examination" method, in which a trench is dug at a distance of 8–10″ from the base of the stool, the width of the trench being about 3 feet, and the depth determined by the depth to which the roots go. It is generally made long enough to include two or more stools, i.e. about 10–15 feet in length. Other methods include those in which the roots are kept in position either by layers of netting or iron-bars, and the soil washed away by means of a jet of water.

Several criticisms can be directed against all these methods, but owing to the absence of a better method, the direct-examination method has been widely used by investigators.

The method used in the present work has never to the writer's knowledge been used previously for the study of sugar-cane root-systems. It is a modification of the method used by Rogers at the East Malling Horticultural Research Station in Kent, for the study of the root-systems of apple trees.

The method will not be described fully in this report owing to limitations of space, but the salient features of the method, are:—1. The marking of a square area of ground with the stool at the centre, (the sides of the square being determined by the length of the roots). The square is divided into areas of 1 foot square, and starting from the outside of the square each square foot is examined in detail to a depth of 6″. The position of each root in the block is marked accurately to scale on graph paper and the inner and outer depth of each root recorded. Each square foot is dealt with in this way until the whole of the big square has been concluded, and the next 6″ layers are then examined in the same way, until the whole root-system has been finished. Every root in each block is given a nomenclature, and labelled, and is denoted by the same nomenclature on the plan. 2. The first stage provides the investigator with all the data required to reconstruct the root system. The second stage consists in reconstructing the root-system in a specially made frame. The final result is a reconstructed root-system occupying exactly the same position as it was in the soil; the system can then be examined and photographed. (NOTE:—Photographs of the reconstructed root-systems cannot be included in this report, but a limited number will be available for distribution to those specially interested, on application to this Department).

The root system of a first Nobilised Glagah cross.—The surface soil of the field where this root system was examined was only 6″ deep, the soil below consisting of a friable reddish brown clay.

The root system in the first 6″ layer is very extensive, spreading fairly uniformly in all directions. The roots in this layer start at a depth of more than 6″ at the stool, but come nearer to the surface as they pass away from the stool, their final terminations being only 3–4″ or even less below the surface of the soil. Towards their terminations they branch profusely, the branch systems generally being very thin and delicate rootlets. Roots in this layer, of 10 feet or more in length have been found: the length of the roots in this layer however, seems to be correlated with the magnitude of the aërial parts of the stool, the more vigorous the stool, the greater the length of the roots. In the stool which was investigated in detail, the greatest length of root attained in this first 6″ layer was about 6 feet.

The roots in the first layer were always cylindrical and rather narrow being also hard and wiry, and brownish black in colour. They showed no compression in passing through the soil, but the older roots were often ribbed as in the shoots of some switch plants.

Sections showed that this was due to a collapse of cortical tissue under the depressions, whereas at other points the cortex was still intact, thus causing a ribbed appearance of the root. It is difficult to see of what benefit, if any, this behaviour is to the root in the carrying out of its functions. This first layer was the only layer which showed new roots, the actual number of new roots being extremely small in a stool of this age under the conditions prevailing at the time. There was one new main root emerging from a young cane and a few new branchlets were borne on the branches of the main roots in the first layer.

There is no doubt that the roots in the first layer function mainly as absorbing roots; they ramify the surface soil for a considerable distance around the stool. This system exploited in a very thorough manner a surface of 16–20 square feet. This area also contained roots from other stools, which emphasises the danger of using the method of weighing roots in the various layers as an indication of the root distribution in these layers. The position of absorbing roots bearing numerous root hairs in the first six inch layer of soil enables the canes to absorb the mineral nutrients which are found in the greatest quantity in this layer, and also to utilise the water from light showers of rain, where it does not percolate to greater depths.

Below the first six inch layer the soil consists mainly of clay. The roots in this layer do not spread out to such a degree as those of the top layer. They are more numerous however, but are much shorter, and do not branch to the same extent as the roots of the first layer. When they do branch the branches are not fine, but approximate more closely to the main roots themselves.

A large number of the roots found in this layer are light orange in colour, being also much thicker, but not cylindrical like the roots of the superficial layer, but compressed in various planes in passing through the clay. These did not show any signs of activity, although sections showed that all the cortical cells were alive, with the exception of a layer or so of suberised cells on the outside. Most of these roots passed out from the stool at an angle of about 45° or so, and continued at an angle along most of their length (one to two feet). Many of them passed more or less vertically down. They thus behave very differently from the roots of the top layer which arise from the stool at a depth of 6–12″, and in passing outwards curve upwards, the outer branching ends being only a few inches below the soil surface. The direction in which they pass outwards, the absence of fine rootlets, and the lack of root hairs, together with the way they are compressed and well adpressed to the clay makes it evident that they are in the main anchoring roots, and do not take part in absorption to any marked degree.

Below a depth of one foot, the roots do not emerge outwards but pass or more or less vertically down into the soil. Like the roots of the top layer they are cylindrical in shape, and are not compressed by the clay like those roots which are mainly found in the second layer. In passing down into the soil they show a very peculiar characteristic. Three or four or even more of these roots borne at very divergent points on the stool, come together and become bound up in the form of a strand, being knitted together by a few branches which are borne on the main roots. The whole system is thus like a rope going down more or less vertically, to depths of about seven feet. It is difficult to explain why roots which emerged at different points on the stool should come together in this manner, for there was no physical obstruction to account for this behaviour. Having once come together and formed an unit, it is probably of great advantage to the roots in pushing their way vertically down through the hard clay. No new rootlets were found on these roots along their entire length. It appears that they are wholly anchoring in function: the association of roots to form such a ropelike

structure constitutes a remarkable adaptation towards this particular function.

It is interesting that the point of origin of these roots was not immediately underneath the centre of the stool, but towards the edges of the stool. The roots immediately underneath the centre of the stool showed a stunted growth and merely form a dense intertwined matting of roots. The cause of this stunted growth is not apparent for here again there was no physical obstruction to their continued growth.

In this particular variety there are thus three well-defined root types :—

1. The main roots which spread out in all directions in the surface soil, and is the framework on which the absorbing system is borne.

2. The underground buttress system which is (except perhaps when the roots are white and actively growing when they may absorb water and salts to a small extent) essentially anchoring in function.

3. The rope-like anchoring system consisting of strands composed of 2–5 roots and their branches which pass more or less vertically down to considerable depths.

The outward appearance of the roots of these three classes show considerable differences, and they may show even more interesting differences of structure.

The root-system as a whole is an extensive, and in comparison with other types a deeply seated one, and seemed to have developed vigorously in soil which was heavily infested with larvae of the beetle Phytalus Smithii, which feeds on cane roots. These larvae were most abundant in the first six inch layer, and none were found below a depth of one foot.

The root system of the variety M. 14/26.—The surface soil was greater in depth (7″–9″) in this plot as compared to that plot where the first nobilised Glagah stool was grown. The indications were that the soil was poor in mineral nutrients and all the canes in this plot made relatively poor growth.

The total area of soil, which had to be investigated in this case was 64 square feet, being a square with 8 feet sides, although some roots were actually followed outside this square. The longest roots found were 10 feet in length. In this case by far the greater number of roots were found in the first 8″ of soil, which in general corresponded to the depth of the surface soil. The roots in the first 6″ layer differed in several respects from those of the system previously examined. The branching of the roots was much more profuse, practically all the roots of this layer giving off innumerable delicate branch roots. This root system was also in a more active state than the first nobilised Glagah stool. Many delicate white rootlets bearing a profusion of root hairs were borne on the branches of the main roots of second and third order. In addition a considerable number of white main roots were found coming out of the centre of the stool.

The total number of main roots coming from the stool was considerably less than in the stool described above, but they were much longer, and branched to a greater extent, so that the absorbing system was more extensive.

This may be due to one or more of the following reasons :—

1. The greater depth, and looser nature of the soil in this plot.

2. The nearly complete absence of larvae of Phytalus Smithii in this plot.

3. It may be due to a real difference between the two varieties.

The root system of the stool of M. 14/26 under the conditions obtaining in this plot was very asymmetrical, the roots being much more strongly developed on one side. That this was not a particular feature of this single stool was proved by the examination of two more stools by the "direct examination" method the trench being dug in the direction which would best show this asymmetrical nature (this direction being known from the stool examined by the Block method).

Although there was a well-developed system of roots in the first 6″ layer, the extent of the system in the next 6″ layer was very limited. Immediately underneath the centre of the stool there were several small stones, these having a hard core, but a fairly thick soft crust A few roots from the stool passed down between these stones and occasionally passed through the soft crust of the rock. The number of anchoring roots was much smaller than in the first nobilised Glagah stool.

In the layers below the first foot, the number of roots was comparatively small, the deepest roots found had only penetrated to a depth of 2 feet 6″ to 3 feet, as compared with about 7 feet in the stool previously described.

It may be said therefore that this variety has a very extensive and efficient absorbing system under these conditions of growth, but a very poorly developed anchoring system.

There were two groups of roots which associated to form the rope-like structure described above, although in this case they only passed down to a depth of 3 feet.

The nature of the roots in the various layers of soil is very similar in this variety to that described for the first nobilised Glagah stool. Most of the older roots in the first layer had the same ribbed appearance, and sections showed that there had been a collapse or disintegration of radial bands of cortical cells, resulting in a caving in of the hypodermal layers at these points. The remaining bands of cortical tissue supported the hypodermal layers resulting in the ribbed appearance of the root. The roots found in the clay subsoil also showed a peculiar morphological appearance ; they were much lighter in colour than those of the surface layer, being light orange to deep orange colour. In cross-section they are seen to be greatly flattened out, so that the diameter in the long direction is 3 to 6 times that in the short direction.

Transverse sections of these roots did not show a marked compression of the cells, suggesting that this appearance of the root may not have been caused by pressure from the soil. The cells are elongated in the direction of the longest diameter, the cortical cells in these roots being also considerably larger than those of the roots from the surface layer, and being somewhat similar to the cells of succulent tissues.

The root system of the variety M. 7/23.—This stool grew in the same plot as the stool of M. 14/26 and in near proximity to the latter stool, so that conditions of soil and moisture content were as similar as possible.

This system was very similar to that of M. 14/26, the roots of the upper six inch layer being very extensive, and exploring an area of about 64 square feet. The longest roots found in this layer were about 10 feet long, and there was profuse branching, giving rise to a system of absorbing roots which ramified the surrounding soil very thoroughly. There seemed, however, to be a greater root growth towards areas which were not occupied by other stools.

In this case also the long main roots which bore a profusion of delicate fibrous roots, seldom passed to a lower depth than 6 to 8". The thick orange coloured roots were again present passing down to the subsoil, and only branching to a small degree, except when they were found passing along the surface, or through the crust of a rock, when there was more branching, the root and its branches becoming closely adpressed to the rock.

The association of roots to form the rope-like structure was also found in this system, but here again they only passed down to a depth of about 3 feet.

This root system can be described as being a shallow, superficial system, the absorbing system being very extensive, but the anchoring system somewhat poorly developed. This may of course be due to the conditions of soil prevailing in this plot.

The root-system of the variety M. 13/18.—This stool was of about the same age as the stool of M. 14/26 and M 7/23 examined, viz: about 12 months. It was situated at the upper end of the same plot, but the depth of soil was greater in this part of the plot, and there was a stream of irrigation water passing in close proximity to this stool. The roots in the first 6" layer were not as long as in the previous stools examined, being mostly only 5 to 6 feet long. At one point the surface soil went down to a depth of about 2 feet, being mixed with loose stones, this being probably due to an excavation having been made in the past. Here the surface roots turned down, there was profuse branching and the whole space was exploited by white actively growing roots.

As a whole, however, the roots in the first layer did not branch to such an extent as in the stools of M. 14/26, and M. 7/23 and the number of white absorbing roots was considerably smaller. This is rather surprising considering the nearer proximity of water, but it was also observed that there was more branching on the side of the stool which was furthest removed from the stream (i.e. about 4 to 5 feet), than on the side nearest the stream. There was a notable difference between this stool, and the stools of M. 14/26, and M. 7/23 from the same plot, namely that the roots in the first layer of soil appeared to be thicker in the former, and the number emerging from the stool was also appreciably greater, although they did not branch to such an extent. The absorbing roots which are usually found in the first 6" of soil here also passed to a greater depth being numerous to a depth of about one foot.

The anchoring system was better developed than in the stools of M. 14/26 and M. 7/23, though not nearly so well-developed as that of the first nobilised Glagah stool. The deepest roots were found at a depth of about 4 feet.

This variety has a root system under these conditions of growth, intermediate in type between the relatively shallow and superficial root-systems of M. 14/26 and M. 7/23, and the deeply seated system of the first nobilised Glagah stool examined.

Some observations on the root-system of P. O. J. 2725.—The stools of P. O. J. 2725 available were not comparable with the other stools examined by the block method, in that they had been grown from single-eye setts, and were much younger. The conditions for growth also did not appear to be suitable, and the amount of growth made was comparatively small. It was therefore not considered worth while to devote the time and labour necessary for an investigation by the block method, and 4 stools were studied by the "direct examination" method.

The superficial spread of the root-system was much less than in the other varieties examined, and the root-system as a whole was actively growing in spite of the dry conditions. Many new white roots were emerging from the stool, and the length of the roots in the surface soil was only 2 to 3 feet The whole absorbing system in this case is situated much closer to the stool than in the previous stools examined. Actively growing main roots which were at the time only 2 feet long were seen, these obviously being of the type that later grow to a length of 6 feet or more, and branch to form the actively absorbing system situated at 5 to 6 feet from the stool. There was a considerable number of downward growing roots which entered into the hard clay to a depth of about 3 feet. The orange coloured anchoring roots were found in this as in all other varieties examined, and in this stool their origin could be demonstrated.

The first roots borne on the "baba" shoots which arise from the cutting or from the rhizome (shoot roots) have been distinguished from those which are borne on the cutting itself or on more mature canes (sett-roots). Shoot roots are much thicker than the sett-roots, and the roots first borne on young "baba" shoots are thicker than those borne subsequently. It is found that these thick orange coloured roots which form the main anchoring system of mature stools, are really shoot roots, which originated from the young "baba" shoots. More will be said about these roots later (see section on development of the root system). The phenomenon by which three or more wiry roots become woven together, and pass down to the lower soil depths has also been observed in this variety.

In many cases roots passing down into the subsoil were dead and decayed for a considerable distance from the tip, whereas higher up they were quite healthy. The decayed parts were covered with a white saprophytic fungus It is possible that the parts of these roots deep down in the subsoil died as a result of lack of oxygen, or other unfavourable conditions of growth.

Under the conditions of growth obtaining in this plot, the P.O.J. 2725 canes cannot be said to have formed an extensive root-system, the spread being only 2′6″ to 3′ from the stool, and the greatest depth only about 3′.

Differences in diameter of the roots of the surface layer.—It seemed from a casual observation that the thickness of the roots in the first six inches of soil differed to a considerable extent in the stools examined.

The diameter of a sample of about 60 roots at their point of emergence from the stool were measured for each stool, and the mean diameter of the roots calculated : the following are the values obtained :—

	Mean diameter of roots	Standard error of mean
M. 13/18 ...	1.91 mms.	0.014
M. 14/26 ...	1.28 „	0.003
M. 7/23 ...	1.79 „	0.007

It seems therefore that there are considerable differences in the mean diameter of roots in the stools, but whether these differences are characteristic of the varieties under all conditions remains to be seen.

II.—Studies of the root-system of ratoon crops.—An investigation has been commenced on the root-system of ratoon crops throughout the season, the main object of this study being to determine the time of application and the most economic methods of applying fertilisers to ratoon crops.

The above investigations have shown that the main absorbing system of the cane is generally situated in the first 8″ or so of soil. In the present study, attention has therefore been confined to the roots in the first layer.

White Tanna ratoon crop.—The root-system both in the interline and between the stools was examined by washing away the soil with a jet of water aiding with a trowel, and fixing pegs in the ground to prevent any possible dislocation of the roots. The crop was cut on October 16th–17th, and the study of the distribution of roots was commenced on October 24th.

This represents the state of the root-system immediately after cutting the crop, and it is proposed to follow the changes in the root-system by examination at intervals of two months through the season.

A comparison of the root-systems with and without tilling the interline is also being carried out.

The position of all the roots in the interline and between the stools is accurately marked to scale on graph paper ; fairly old brown or black roots being marked by a continuous line, while new white roots are marked as dotted lines.

The root system at one week after harvesting the crop.—The interline between the rows of cane is ramified in all directions by roots from the adjoining stools. At a depth of 6″ and more the roots are quite black in colour, and bear no root hairs being therefore probably non-functional from the absorptive point of view. In the first six-inch layer, every cubic inch of soil is explored by the main roots and their branches. Indeed the branching was so profuse that it was only practicable to mark the main roots on the charts. The amount of branching is greater in the interline than close to the stool, the thin delicate rootlets being at this stage, yellowish brown in colour. When examined microscopically all these yellowish brown roots bore a profusion of actively functioning root hairs. They were proved to be actively functioning by plasmolysis in sugar solutions.

There were few white rootlets borne at this stage, but the light brown colour of the rootlets which were present showed that they were of fairly recent origin.

There were comparatively few new white roots emerging from the stool, those that were present were borne on the older babas, and short ones were emerging from the few remaining nodes of the canes which had been harvested. The density of the roots in the present instance was greater in the interline than between the stools in a row, and the density of absorbing roots was much greater in the interline, than close to the stool.

D.K. 74 ratoon crop.—The distribution of roots in the first six inch layer was examined in the same way as described for White Tanna This variety was chosen for comparison with White Tanna, and because there was a greater number of actively growing "baba" shoots as compared with the White Tanna plot. The distribution of roots in the interline was as dense in this variety as in the case of White Tanna; and the main roots bore a profusion of light brown rootlets bearing a vast number of root hairs, as was the case in the White Tanna plots.

Here again there were not many new white roots, although the number was greater than in the case of White Tanna. The young babas had not as yet given off any shoot roots, practically all the white roots which were present being borne at the base of cut canes. Some of the long roots passing well into the interline bore a few white rootlets.

Thus it follows that the main absorbing function is not carried out by new white roots and rootlets since these are very few in number, but is carried on by the fine rootlets in the first 6-8 inches of soil between the rows and to some extent between the stools in the row. These fine rootlets must function for a considerable time for although they are now yellowish brown in colour, and seemed to have ceased growing, they are still densely covered with vigorously absorbing root-hairs. The young babas therefore do not depend on the few new white roots present, but are well supplied by the fully formed absorbing system of the crop just harvested.

Owing to the limitations of space the bearing of the root work so far carried out upon problems of culture, and applications of fertilisers, will not be discussed in this report, but when the work is complete it is hoped to publish a bulletin on the whole subject, in which its economic applications will be fully discussed.

III.—The development of the root system from the cutting.—For the study of the development of the root-system of the stool for the first three months, the method employed was a modification of Venkatraman's root box method. The box consists of a stout frame, on which is fixed detachable sides. Venkatraman used horizontal sheets of wire netting borne at intervals on the frame. It has been found that there is a tendency for the wire netting to cave in, under the weight of soil, and also when the soil is washed away there is a tendency for roots passing out from the cutting more or less horizontally to fall until they rest on the layer of netting immediately below.

To overcome these effects we have fitted the boxes with both vertical and horizontal layers of netting. The vertical layers of netting were fixed to the bottom of the box, and suspended at the top from thin iron bars, being tightly stretched, so that they could not be moved from the vertical. The horizontal sheets of netting were fixed on to the

vertical sheets, and also supported by wire from the iron bars fixed to the top of the frame. This was so satisfactory that the sheets of netting could not be shifted from their position, even by the exertion of a considerable force. The soil was well-packed in the boxes, the layers of soil being packed in the same order as they occurred in nature. The size of the boxes were, 2 ft × 2 ft × 2 ft for the 1 month plantings, 3′ × 3′ × 3′ for the 2 month plantings, and 4′ × 4′ × 4′ for the 3 month plantings. There is thus little danger that the boxes will limit the growth of the cuttings in any way. The variety used was B H. 10 (12), and all cuttings were planted on October 18th, 1932. After intervals of 1 month, 2 months, and 3 months respectively, the sides of the boxes were removed, and the soil washed out by means of water from a hose-pipe. The root-system was thus held in position by the netting, and can be studied and photographed.

The root-system of B.H. 10 (12) at one month.—Examined November 18th. The root-system at one month is composed entirely of sett-roots, i.e. of roots which emerge from the root primordia just above the nodes of the cutting. The germination of the cutting shows several interesting features.

1. There is a marked polarity demonstrated in the cutting, in that the apical end of the cutting bears the new shoots, the basal end bearing roots. It was more marked for the roots than for the shoots, the roots being confined to one end of the cutting, whereas buds occasionally developed into shoots from the apex to the centre of the cutting.

2. In the case of the roots arising from the root-primordia, (which are situated in a ring just above the nodes), those primordia which are situated on the side of the cutting which happened to be the lower side, develop far more strongly than those which are situated on the upper side of the cutting.

3. The sett-roots are admirably adapted for the absorbing function. They branch profusely, the branchlets bearing an enormous number of root-hairs.

Owing to the comparatively looser nature of the soil in the boxes as compared to natural conditions, the roots grew to a greater depth than probably occurs in nature. The longest root found at this stage was 16 inches long.

The root system of B.H. 10 (12) at 2 months.—Examined December 19th—The root system developed to a greater extent during the second month as compared to the first month after planting, but this may be due to the better conditions for growth during the second month.

Many of the features which were characteristic of the cane at one month of age, can still be observed at two months. The polarity of the cutting can still be demonstrated, the shoots having been formed from buds at the apical end of the cutting, the buds at the basal end remaining dormant though some buds at the centre had begun to swell. Roots were far more numerous and better developed at the basal nodes of the cutting, but some roots were borne on all the nodes up to the apex.

Those roots which were formed from the root primordia which happened to be uppermost, are still very poorly developed, and a large number have actually aborted and died.

The sett roots have developed to a remarkable degree being profusely branched and bearing a dense covering of root hairs. They have a mean length of 1′ to 1′ 6″ and pass outwards either horizontally or at an angle up to 60° from the horizontal.

Shoot roots, (i.e. roots borne at the base of the young shoots which have developed from the apical buds of the cutting) are also well developed. These are much thicker than the sett-roots, and also thicken during their growth, so that they are much thicker at some distance from the cutting, than at their point of attachment.

They pass down almost vertically, and must grow at a very fast rate, for after one month of growth they are about two feet long. They only bear root hairs at the actively growing region just behind the tip, being almost devoid of root hairs along the greater part of their length. It is these thick roots that can be observed in fully grown root-systems passing down into the clay, and becoming contorted into various shapes in passing through the layers of clay. They are nearly always orange coloured in mature root systems contrasting with the dark brown or black roots in the surface soil. The root system at three months has not yet been examined.

IV. The study of the growth of individual roots.—This work has only been recently commenced. It involves the growth of cuttings in boxes, one side of which is composed of thick glass marked in square centimetres. This side is at an angle of about 30° to the vertical. Roots from the stool grow against the glass, and their growth is followed by marking their position daily on graph paper.

The Analysis of Growth Rate Experiments 1930–31 and 1931–32

The analysis of the growth-rate experiments for two consecutive years has now been completed, and several interesting features in the manner of growth of White Tanna and P.O.J. 2878, and the effect of external conditions on the rate of growth have been elucidated. It is impossible to include the data in this report, and it has therefore been decided to publish the results in the form of a separate bulletin in the near future.

Only a brief summary of the data will, accordingly be given here.

Growth rate experiments for the period 1930–31. During the period from October 1930, to September 1931 the rate of growth of the sugar cane varies to a marked degree. It is at first comparatively low (from the beginning of October to the middle of December) thereafter increasing rapidly to a maximum (end of January to the beginning of February) and then diminishing again, the immediate cause of this drop being a dry spell. At the beginning of March 1931 there was a severe cyclone, and the rate of growth sank to a very low value, but increased again to a maximum from the middle towards the end of May. Finally from the beginning of June onwards the rate of growth diminished markedly, remaining at practically zero for the rest of the season.

The growth rate at any time was significantly correlated with such external conditions as temperature, soil-moisture, relative humidity of the air, etc.

Growth rate during the period 1931–32. The main trend of the curve is similar during this season to that of the previous season, but it is interesting to see that the " grand season " of growth,—during which the cane grows at a very fast rate lasted 2—3 weeks longer than in the previous year, presumably because the grand season of 1930–31 was cut short by the incidence of a cyclone. The actual conditions of growth during the grand season were also better in the year 1931–32. These two reasons probably account for the very large crop obtained in the island in 1932 as compared to that in 1931. It has been found that there have been three well defined peri ds in the growth of the cane in Mauritius, during which external factors, especially temperature and soil moisture have different effects on growth. These three periods are : —

1. The period preceding the grand season, i.e. September to December.

2. The grand season itself (i.e. January to beginning of April).

3. The period following the grand season, i.e. (beginning of May to September.)

During these periods soil moisture and temperature cause a markedly different response in growth rate. The effects of individual factors, and the combined effect of the factors have been determined for these three periods.

The Isolation of Cane for Crossing Purposes

For critical crossing work it is desirable to exclude any possibility of foreign pollen reaching the stigmas of the variety used as female parent. This is to some extent achieved by surrounding the female parent with canes of the male parent with which a cross is desired. The only method which is certain to exclude all foreign pollen however is to isolate the cane from the stool in some way, and bring it into a pollen proof crossing chamber before the flowers open, and to effect the cross inside the chamber.

In the main two methods have been investigated :—

(1) The rooting of individual canes ; (2) The preservation of cut canes in various solutions.

(1) *The rooting of individual canes.*—This method was first exploited in India where earthenware pots filled with soil were placed round the cane. Roots develop from the root-primodia just above the nodes under these conditions. When the new root system has been formed, the cane is severed below, and thus an isolated cane is obtained for crossing purposes. This method had been tried during the 1931 crossing season, but the results obtained were not satisfactory, and it was therefore decided to investigate the method in more detail in the 1932 crossing season The results of the various experiments carried out on this problem, will be briefly given here.

1. Rooting takes place more readily at the base of the cane, and the ease of rooting decreases from the base upwards.

2. Wounding causes a slightly greater root-formation, but not sufficient to use the wound treatment as a routine practice.

3. Different varieties differ markedly in the ease with which they form roots, under these conditions. The best eight female canes used can be placed in the following order according to their rooting capabilities,

1. M. 33/19	} good rooters
2. M. 109/26	
3. Ba. 11569	
4. M. 25/22	
5. M. 1/77	
6. M. 55/74	} poor rooters
7. R. P. 6	
8. M 4/22	

4. Rooting depends to a considerable extent on the nature of the rooting mixtures. Seven rooting mixtures were tried, viz : soil alone ; soil and coir ; soil and sphagnum moss ; soil and bagasse ; soil and dung ; coir and dung ; bagasse and dung.

There is a well defined difference between the soil mixtures and the dung mixtures. There is a far greater number of roots emerged in the dung mixtures, but the mean length of the roots is consistently greater in the soil mixtures. There is, in general, considerably more branching in the dung mixtures.

It appears as if a mixture of soil and dung in the proportion of 1 : 1 or 1 : 2 will be the most efficient rooting mixture.

The success of the severed canes in establishing themselves after the formation of the induced root system appears to be proportional to the extent of the new root system. Thus the arrangement of the eight varieties used according to the number successfully established after severing, is identical with the arrangement according to capacity for rooting. It must be noted that what is meant by successful establishment is that the canes are able to withstand the shock of severance without any wilting either temporary or permanent If even a slight temporary wilting occurs, the arrow fails to protrude, even though after a day or two the canes are well established. For the purposes required these are therefore as much failures as those which wilt permanently and consequently die.

5. Washing the nodes with ether to remove the wax, in the case of some varieties causes a considerable increase in the roots emerged.

6. Automatic irrigation of the rooting mixture has a very beneficial effect on the rooting. Several methods were tried, and the best method proved to be a tin funnel placed immediately below the rooting mixture, and kept filled with water.

7. The ease of rooting depends upon the morphological age of the plant—those canes which are formed in the cold season, and which are characterised by the presence of short internodes at the base of the stem root much better than those canes formed in the growing season, and which have long internodes at the base of the stem.

8. The extent of the induced root system is increased by increasing the number of nodes covered.

The conclusion drawn from all the experiments is that by a correct combination of all factors such as rooting mixture, number of nodes covered, correct irrigation, and the choosing if possible of canes formed in the cold season, all the varieties investigated can be successfully isolated by this method.

(2) *The preservation of canes in various solutions* :—This method is almost universally used in Hawaii for the isolation of arrows, but the method does not seem satisfactory in most other cane-growing countries

In Hawaii 0.03% SO_2 is used as the preservative solution, but more recently a new solution has been found to be more efficient, viz 0.01% $SO_2 + 0.005\%$ $H_3PO_4 + 0.005\%$ H_2SO_4. Hawaiian workers claim that female arrows can be kept in such solutions until the seeds ripen (a period of 30 to 40 days).

The explanation given of the mode of action of these solutions is that they inhibit bacterial action at the cut surface, and thus prevent blocking of the vessels.

Our experiments here have demonstrated conclusively that these solutions do not act in virtue of their bactericidal action but in virtue of their reducing action. Cut canes placed in water wilt in a comparatively short time (12 hours or less), the vessels being blocked up by a reddish-brown substance which was shown to be a result of the oxidation of organic substances by the oxidising enzymes oxidase and peroxidase. Other reducing agents besides SO_2 solution, are effective to a greater or less degree in preserving cane.

Oxalic acid was found to be as efficient as the solutions used in Hawaii, but all these solutions including the Hawaiian solution have a toxic effect and the leaves turn yellow in a comparatively short time.

An attempt was made to find a solution which in virtue of its reducing action could keep the cane alive, and which also had no toxic action. The nearest approach to this was 0.5 or 1% invert sugar, but it proved to be an inferior solution to the above, although canes were kept alive for 5–6 days, and in one instance for 20 days in this solution.

On the whole the new Hawaii solution is the best, but the length of time during which the canes remain alive in these solutions depends upon the variety, some varieties remaining alive for 20 days while others die after 4 to 5 days.

A large number of other experiments were carried out in an attempt to prolong the life of the canes, such as stripping the leaves, coating with vaseline to reduce transpiration, removing the vascular bundles from the central region of the cane, etc, but no marked success was obtained.

It is felt that preservation of female canes in these solutions can never be a satisfactory method here, owing to the differences between varieties in the time for which they remain alive.

The method however is quite satisfactory for male canes, which have only to be kept alive for 5 to 10 days.

The following large scale experiments have been recently laid down.

Course of Growth Experiment

An experiment to determine the course of growth in the sugarcane has now been laid down, White Tanna being the variety used. It consists of one plot, divided into six blocks each containing 130 cuttings. The plot has a border row running completely round it, and trenches have been dug to eliminate the effect of trees and bushes outside the plot, on the soil conditions inside the plot. The plot has been chosen to be as uniform as possible, and all the cuttings planted were weighed before planting and only cuttings between certain limits of weight were used. Maize has been planted between the rows for the first three months to serve as a trap for cane borers. It is proposed to take a random sample of 4 or 5 stools from each block, i.e. of 25 to 30 stools from the whole plot, at intervals of one month, and to determine the fresh and dry weight of all the organs and the leaf area. The course of stem, leaf and root growth, and the activity of tillering can thus be followed for the whole growth period of the cane.

An initial sample of 25 cuttings were analysed at planting time. The following are the results of the analysis:

Mean fresh weight	Concentration of sucrose in		Mean total weight of sucrose in cutting	Mean sucrose content % fresh weight	Mean % dry matter	Mean sucrose % dry weight
	100 cc juice	100 gr juice				
198 grs	18.04%	15.3%	27.6 gr	11.0%	28.46%	37.06

The constitution of the cuttings planted are thus known, and it will be seen whether there is any relation between final weight of stool and the weight of cutting planted.

In order to be able to measure the leaf-area quickly, when the samples are taken, a method of finding the leaf area of sugar cane has been worked out. It is based on the length and breadth method used by Gregory at Rothamstead for the leaves of Cereals.

Random samples of 70 leaves were taken from a plot of White Tanna canes at C.E.S. The length, breadth and true area of all these leaves were measured. The true area was determined by placing a long glass sheet marked in square centimetres with black Indian ink, on the leaf, pressing it flat against the leaf. By counting the number of centimetre squares covered by the leaf, the true area was obtained. A factor was then calculated for each leaf, the factor being $\frac{\text{Actual area}}{\text{Length} \times \text{Breadth}}$ The mean factor for the sample of 70 leaves and its standard error was calculated.

In the case of mature leaves of White Tanna the mean factor was 0.821 and the standard error of the mean 0.0007. Young leaves borne on "baba" shoots had a different factor, viz 0.807 (standard error of mean 0.0021). The difference between the mean factor for young and mature leaves is not large, but it is nevertheless significant.

The method to determine the area of the leaf in the variety White Tanna is therefore to measure the length, and the breadth : the product of these multiplied by the factor gives the true area.

The factor to be used for mature leaves is 0.821, and the young leaves 0.807; this method gives the area of mature leaves to about 3.4%, and the baba leaves to 3.9%. The accuracy in both cases will therefore be roughly 4%.

It will therefore be possible to determine quickly the total leaf area per month in the growth experiment, by using this method.

The constant has also been worked out for the variety B.H.10 (12), which has a differently shaped leaf to White Tanna. The constant for this variety was 0.721 (standard error of mean 0.001). This method gives the leaf area of B H.10 (12) to an accuracy of about 4%.

It is hoped to take the first monthly sample in the course of growth experiment in January 1933.

Experiments on the Control of Arrowing

A plot has been laid down in which different experimental treatments are being applied, in the hope of affecting :—

(1) The degree of flowering of a variety.

(2) The time of flowering.

(3) The degree of male and female fertility.

These results would be of tremendous importance in the crossing programme, since there is a limitation to the crosses which can be affected because :—

(*i*) Certain varieties do not flower, or only flower to a small extent in Mauritius.

(*ii*) Some varieties are either male or female sterile, or are equally male and female. Control of the sex would open unlimited possibilities in this direction.

The experimental treatments are as follows :—

1. *Planting at different times through the year* :—Schaffner, in America, has obtained complete success in his attempts to control flowering, and the sex-nature of flowers in maize, by making bimonthly plantings throughout the season. His results probably represent a photoperiodic effect. Although in the tropics the variations in length of day at different times during the year are not large, it has been considered worth while to lay out this experiment, plantings being made monthly. Three different varieties have been used with definite objects in view : the varieties being M.33/19 which is wholly female—with the object of causing it to become male ; B.H.10 (12) which does not normally flower at all in Mauritius, with the object of causing it to flower ; D.K. 74 which is both male and female though a better male than a female, with the object of causing it to become either wholly male or wholly female. Twelve stools of each variety are being planted at monthly intervals,

2. *Different manurial treatments.*—Four different treatments are being applied, viz:—

(*a*) Growing in alkaline soil with a heavy dressing of lime (in Barbados this is said to cause earlier, and more profuse arrowing).

(*b*) Growing the canes in a soil very rich in phosphate.

(*c*) „ „ nitrate.

(*d*) „ containing no nitrate.

All these treatments have been said to affect arrowing.

The variety D.K. 74 has been used in all cases, there being 36 stools of each treatment. The experiment was laid down on October 30th, 1932.

Sett-Soaking Trial

Two sett-soaking trials have been laid out, one at Trianon S.E. in which the variety White Tanna was used, and one at Pamplemousses Experimental Station in which the variety B.H. 10 (12) was used. The treatments in both trials were.—Controls (untreated); cuttings soaked in, (*a*) Saturated solution of lime. (*b*) Saturated solution of lime containing 1 lb Magnesium sulphate per 50 gallons. (*c*) Complete nutrient solution (Knop's solution, three times normal strength). (*d*) Water alone.

The time of soaking at Trianon was 24 hours, and at Pamplemousses Experimental Station 8 hours. The object of the experiment was three-fold.

1. To kill any insects or cane borer larvae either on or in the setts.

2. To try and cause quicker and better germination.

3. To try and effect an increased yield, as a result of the cutting starting off with a better supply of food material.

The cuttings at Pamplemousses Experimental Station were badly infested with cane borers, and the effect of soaking was to cause a considerable mortality of the larvae. They were found dead, with their bodies partially emerged from their holes. The lime, and lime + magnesium sulphate appeared to cause the highest mortality, but there was a considerable mortality in the other solutions also.

The Faulkner plan of layout was used both at Trianon S.E. and at Pamplemousses Experimental Station. At Trianon S.E. there were 30 cuttings per row, and eight replications of each treatment. Owing to the smaller area of ground available at Pamplemousses Experimental Station there were 25 cuttings per row, and 7 replications of each treatment.

The percentage germination of the control and treated setts at intervals after planting are now available. The total number of cuttings used as controls was 1,020, and the number of each of the experimental treatments was 240.

Days after planting	% Germination				
	Controls	Treatment A	Treatment B	Treatment C	Treatment D
	%	%	%	%	%
25 days ...	0.2	45.4	36.7	28.3	12.1
36 ,, ...	13.6	89.6	82 9	81.3	50.1
53 ,, ...	78.7	98.8	95.0	98.0	91 2
Final establishment ...	92.8	99.0	95.0	98.0	95.0

After 25 days and also after 36 days the differences between all the experimental treatments are quite significant. After 53 days the difference between treatments A and C is no longer significant, all the other treatments still being significantly different. The final number established in the experimental treatments is better than the controls, and would have been better still but for the fact that a few were attacked by borers and died, after they had germinated.

Results for the Trial at Pamplemousses Experimental Station

The number of control cuttings was here 750, and the number of each treatment 175. The treatments were the same as at Trianon, but the soaking only lasted 8 hours.

Days after planting	% Germination				
	Controls	Treatment A	Treatment B	Treatment C	Treatment D
	%	%	%	%	%
33 days ...	45.2	98.9	98.9	100.0	98.3
Final establishment ...	91.0	99.4	100.0	99.0	99.4

Thus the germination and final establishment was significantly better in the experimental treatments than the control treatments.

These experiments were all planted in October in the very dry season. It will be seen that the treated cuttings germinate both quicker and better than the controls.

Whether there will be a difference in yield between the controls and the different treatments remains to be seen : but even if there is not a marked increase in yield there is no doubt that the soaking of setts should become part of the routine of planting in Mauritius.

As far as quickness and percentage germination is concerned, a saturated solution of lime seems to be the best, with a soaking period of 8 to 12 hours. The final effect on yield may however be greater for some of the other solutions, but this remains to be seen.

It is quite probable also that the general adoption of the principle of soaking setts before planting will lead to a very marked decrease in the incidence of cane-borers in the colony.

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PART III

BIO-CHEMISTRY

Soil Analyses

Soil analyses will be only briefly dealt with here as it is intended to publish a full report on this subject shortly.

The numerous soil samples collected and analysed up to date are fairly representative of the sugar cane areas of the island and are at the same time located in widely different climatic zones.

The analytical methods used were for the most part the same as those previously described. A comparison of the H_2O_2-HCl-NaOH method already adopted for mechanical analysis and of the new NaOBr-NaCl method of Troell (J. Agric. Sci July 1931, p. 476) was made on a few soil samples from the North. The following table shows that the two methods give similar results.

TABLE I

Soil No.	Method	Coarse Sand	Fine Sand	Silt	Clay	Loss in Solution
71	H_2O_2–HCl–NaOH ...	0.8	10.3	15.6	72.8	0.7
71	NaOBr–NaCl ...	1.3	13.1	17.0	69.8	—
78	H_2O_2-HCl–NaOH ...	4.7	24 0	23.8	40.8	1.9
78	NaOBr–NaOH ...	6.0	26.0	26 3	41.7	—
80	H_2O_2–HCl–NaOH ...	0.7	6.5	21.5	69.0	0.6
80	NaOBr–NaCl ...	1.2	11.7	18.8	68.4	—
82	H_2O_2-HCl–NaOH ...	2.6	10.4	21.9	60.9	1.2
82	NaOBr–NaCl ...	2,9	13.7	26.4	59.0	—

The H_2O_2 test for detecting the presence of Manganese dioxide was applied to a number of soils, a considerable rise in temperature being noticed in some cases

All the determinations of potassium soluble in concentrated HCl were made by the cobaltinitrite method, the technique followed for precipitation and centrifuging being that of Delaville and Carlier (Comptes Rendus, T. 182, p. 701) while the nitrite in the precipitate was oxidised by means of permanganate as indicated by Milne (J. Agric. Sci. 1929 p. 541) A limited number of comparisons showed that for extracting the exchangeable potassium, leaching with normal ammonium acetate (ratio of soil to liquid 1 : 40) is more efficient than leaching with N/2 acetic acid, using the same ratio.

The easily soluble phosphate content of the soils was determined by two different methods (i) the 1% citric acid method of extraction followed by analysis according to Warren and Pugh (J. Agric. Sci. Vol. 20, 1930 p. 532) ; (ii) Truog's Method (J. Amer. Soc. Agron. Vol. 22, 1930 p. 874) involving extraction with 0.002N H_2SO_4, buffered to pH 3 with ammonium sulphate.

For organic carbon analysis the modified sulfo-chromic method of Schœllenberger was used with silver dichromate instead of potassium dichromate.

The total base exchange capacity (T value) of the soils was found by determining the absorbed ammonia after leaching the soil with neutral normal ammonium acetate and removing the excess with neutral methyl alcohol. The sum of exchangeable bases (S value) was found by the titration method of Bray and Wilthite (Ind. Eng. Chem. (Anal. Ed.) (Vol. 1 p. 144) after calcination of the leachate followed by the determination of the exchangeable calcium (Ca value) volume trically.

The exchangeable hydrogen (H value) or so called lime requirement was taken as the difference between total base exchange capacity and the sum of the exchangeable bases. The reaction was determined colorimetrically from the clear dialysate obtained through a collodion bag (Method of Pierre and Parker, Soil Science, January 1927 p.13.)

Results

In general all the soils examined were rich in clay, the highest proportion (up to 78%) being met with in the soils free from stones located in the dry and medium rainfall regions. Lower clay contents were found in the rocky soils all over the island and in the soils free from stones of the wet regions. No relation was found between texture as judged by mechanical analysis and structure in the field, the soils being generally permeable.

In the chemical analysis the concentrated HCl method was followed and the insoluble residue was taken as combined silica, all the soils being practically free from quartz. The mol. $\frac{SiO_2}{R_2O_3}$ ratio and mol. $\frac{SiO_2}{Al_2O_3}$ ratio of the soils have been calculated and given as a measure of their degree of laterisation. The general conclusion is that the higher the rainfall the further has laterisation proceeded, the only serious exceptions being the rocky soils of the wet regions which persistently show a much lower degree of laterisation than the neighbouring soils which are free from stones. In the drier regions, the difference in degree of laterisation of the free soils and rocky soils is less pronounced.

The negative correlation between combined water (H_2O+) content and degree of laterisation as shown by the mol. $\frac{SiO_2}{Al_2O_3}$ ratio is well illustrated in the attached results.

There is much variation in the colour of soils examined but the typical red colour is confined to the free soils of the dry regions and the typical yellow colour to the highly laterised free soils of the humid regions. In general rocky soils tend to be darker.

The amount of exchangeable bases left in the soil and the reaction seem to depend on the intensity of the leaching to which the soils have been subjected. On the one hand we find the nearly neutral soils of the dry regions which have retained a large proportion of their exchangeable bases and on the other the very acid soils of the wet regions which have lost most of their bases. The few soils of the wet regions which do not show high acidities had received heavy applications of liming material. The exchangeable base present in largest amount is calcium. However the proportion of calcium to other bases is lower in soils of dry regions than in those of wet regions where calcium may be the only base present in appreciable amounts.

A good positive correlation is obtained between moisture content at 50% relative humidity and total base exchange capacity (T value). The "T" value is lowest in highly laterised soils and highest in slightly laterised ones, the proportion of organic matter generally tending to increase this figure.

As would be expected the lime requirements (H value) of the dry regions are much lower than those of soils from wetter regions. The close relationship between the percentage of base saturation (V value) and pH value is apparent in all the samples examined. The formula linking the two values published in last year's report still holds good.

In general the P_2O_5 content (soluble in concentrated HCl) is fairly high.

The easily soluble phosphate content determined by Dyer's 1% citric acid method and by Truog's Method agree well except in the cases of soils rich in organic matter where the last method always yields lower results. Considerable differences have been found in the easily soluble phosphate content in the case of soils from both the low, and medium rainfall regions. In the highly laterised soils of the wet regions which are at the same time poor in lime, the easily soluble phosphate content is as a rule very low.

The results of determinations of K_2O soluble in concentrated HCl are very interesting showing that the soils rich in K_2O lie the dry districts whereas those poor in K_2O are located in the wet regions. It follows that there is a definite relation between lime and K_2O content, heavy leaching eliminating both of these elements. The few exceptions occur in places where acid soils have been liberally limed, the K_2O content being of course unaffected. The above considerations tend to prove that it is difficult to build up a reserve of potassium in soils subjected to strong leaching

The soils examined were rich in organic matter the highest amount being found in the soils of the wet areas especially the rocky ones. The The C/N ratio is fairly constant although slightly lower in the soils from dry climates.

In general high organic matter is associated with high total base exchange capacity and with high moisture content at 50% relative humidity.

The loss in solution during mechanical analysis is largely governed by the content of organic matter indicating that in the soil organic matter retains much iron and aluminium.

An abundant amount of nitrogen is common to all our soils, the richness varying according to the quantity of organic matter present. However, little is known at present concerning the availability of this large store of important plant food.

General Conclusions

Leaving out local variations and intermediate types, three different classes of soils are found in the island.

1. The slightly laterised soils of the hot and dry areas (Rivière Noire, Pamplemeusses, Rivière du Rempart and the lower parts of Savanne, Grand Port, Flacq, Plaines Wilhems and Moka) which are nearly neutral and chemically rich, water being apparently the limiting factor for sugar cane growth.

2. The laterised soils in regions of medium temperature and rainfall (medium altitudes of Flacq, Savanne, Grand Port, Plaines Wilhems and Moka) which, although they have an acid reaction have still an appreciable reserve of plant food and, owing to the favourable climate in which they lie, probably form the best soils for growing sugar cane.

3. The highly laterised soils of the cooler and rainy regions of higher altitudes. These show high acidities together with chemical poverty and require careful agricultural practice to retain or enhance their fertility. Nevertheless they can give satisfactory yields because of the continual amount of water at the disposal of the growing sugar cane which thus makes the best use of the small store of plant food available.

TABLE II

LOCATION OF SOIL SAMPLES

Sample No.	Location	Sample No.	Location
1–58	Location and analytical data given in annual report, 1931	86.	Beau Vallon, Rivière La Chaux, F. 39
		87.	Beau Vallon, F. 84
59.	Pierrefonds, F. 27	88.	Ferney, F. Hospital 225
60.	Cressonville, opp. shop	89.	Ferney, F. Mammelon 43
61.	Beau Songe	90.	Mon Désert (Carié) Field Desplaces
62.	Beau Songe		
63.	Médine, Carreau Jacques	91.	Mon Désert (Carié) F. Macon 135
64.	Govt. Tobacco Station		
65.	Richelieu, Carreau Verger	92.	Mon Trésor (Deux Bras) F, 4
66.	Richelieu, ,, Nosibon		
67.	Cerné, F. 5 (lower part)	93.	Union (Flacq), F. 16
68.	Cerné, F. 16 (upper ,,)	94.	Union (Flacq), F. 85
69.	Anna, Field Jean Charles	95.	Queen Victoria, F. 30
70.	Anna, Carreau Coton	96.	Queen Victoria, F. 56
71.	Solitude, F. 208	97.	Queen Victoria, F. 90
72.	Solitude, F. 172	98.	Constance (d'Arifat), La Mare
73.	St. André, F. 62A		
74.	St. André, F. 41	99.	Constance (Belle Vue) Allendy
75.	Near " Vale " old mill		
76.	Mon Loisir(Rouillard) F. 39	100.	Beau Champ, Trois Ilots, F, 36
77.	St. Antoine, F. 447		
78.	St. Antoine, F. 3	101.	Beau Champ, Grand Port, F, 18
79.	Labourdonnais, F. 81		
80.	Labourdonnais, F. 48	102.	Beau Champ, Littoral, F, 33
81.	Beau Séjour, F. 18 (Mon Choisy)	103.	Deep River, F. 26
		104.	Deep River, F. 100
82.	Beau Séjour, F. 81 (Mon Piton)	105.	Olivia, F, 80
		106.	Belle Rive, F. 75
83.	Mount, Annexe Grande Rosalie Plateau, F. R. 136	107–110	Valetta, La Mare
		111.	St. Aubin, P_2O_5 trial 1932
84.	Mount, Annexe Grand Dufailley. F. 131	112.	Rivière des Anguilles, K_2O trial 1932
85.	Mount, Plessis, F. 131		

TABLE III

Mechanical Analysis

% Dry soil

Sample No.	Stones & Gravel % whole soil	Coarse Sand	Fine Sand	Silt	Clay	Organic matter Org. C x 1.724	Loss in solution
59	22	5.5	25.2	18.7	45.1	4.5	1.7
60	9	2.0	19.0	23.8	52.9	3.9	1.3
61	5	1.1	12.5	16.6	65 3	3.6	1.5
62	40	5.4	25.2	21.7	36.6	7.3	3.4
63	32	1.7	12.0	17.0	62.7	5.1	1.3
64	24	0.4	8.8	11.6	74.1	3.9	1.0
65	3	0.4	12.6	19 0	63.1	4.8	1.3
66	3	0.3	9.9	10.8	72 8	3.7	1.0
67	6	1 0	14.1	19.6	62.4	4.2	1.2
68	1	0 3	8.0	14.3	76.2	3.2	1 0
69	18	1.0	14.4	15.9	66.1	3.5	1 3
70	9	3.2	25.8	19.6	48.0	3 4	1.3
71	6	0.8	10.3	15.6	72.8	4.1	0.7
72	8	0.7	9.1	16.3	75.3	4.7	0 7
73	2	1.0	6.6	18.5	75.5	4 4	0 6
74	15	1.4	5.7	16.4	76.0	4.1	0.7
75	67	4.2	22.6	17.8	52.3	5.7	1.5
76	64	2.4	15.9	17.7	57.0	6.9	2.3
77	48	1.8	9.4	17.7	73.3	5.8	0.7
78	77	4.7	24.0	23.8	40.8	6.3	1.9
79	32	2.4	12.5	22.5	60.0	4.3	1 4
80	1	0.7	6.5	21.5	69.0	4 5	0.6
81	9	1.0	16.4	19.1	60.5	5.1	0 7
82	31	2.6	10.4	21.9	60.9	4.4	1 2
83	1	0.5	9.1	23.2	65.2	4.2	0.9
84	1	0.3	11 9	23.4	63.0	4.2	1.1
85	1	0.5	5.0	17.8	73.9	4.7	0.9
86	57	2.3	17.4	18.4	54.6	6.1	2.4
87	1	0.4	6.8	19.0	69.8	6.5	0.8
88	36	5.5	18.9	25.6	50.7	4.4	1.1
89	17	6.7	18.1	25.7	47.2	4.6	0.6
90	67	3.6	18.0	20.6	49.0	7.6	2.0
91	33	2.2	14.0	24.1	53.3	5.3	2.0
92	1	0.9	15.9	28.9	50.4	6.2	1.1
93	40	1.1	10.7	25.4	59.2	6.1	1.3
94	32	1.4	12.7	23.6	56.8	5.8	1.4
95	33	0.8	7.6	17.2	69.0	5.4	1.0
96	35	0.3	7.7	17.7	68.1	5.9	1.0
97	24	2.0	15.1	19.0	58.2	5.6	1.1

TABLE III, Etc.—(*Continued*)

% Dry soil

Sample No.	Stones & Gravel % whole soil	Coarse Sand	Fine Sand	Silt	Clay	Organic matter Org. C. x 1.724	Loss in solution
98	1	0.4	21.6	24.8	47.9	3.5	0.8
99	9	0.6	9.9	21.6	62.3	5.7	0.6
100	4	0.3	11.1	20.8	62.5	5.5	0.7
101	3	1.2	7.5	12.1	75.7	6.0	0.7
102	61	1.2	8.8	17.7	68.2	5.8	0 8
103	1	1.3	16.7	31.4	49.1	5.7	0.8
104	49	3.1	12.3	26.9	51.5	7.0	2 2
105	1	1.0	15.3	30.6	50.8	4 8	0.7
106	1	1.1	14.3	20.9	61.5	5.1	1.0

TABLE IV

Chemical Analysis

Soluble in concentrated HC l *% dry soil*

Soil No	Insoluble matter ($Si O_2$)	$Fe_2 O_3$	$Al_2 O_3$ + $Ti O_2$	Molecular $\frac{Si O_2}{R_2 O_3}$	Molecular $\frac{Si O_2}{Al_2 O_3}$	Combined Water $H_2 O+$
45	9.6	25.9	39.4	0.29	0.42	20.2
46	20.2	19.3	31.1	0.79	1.10	16.5
47	35.5	19.3	25.6	1.59	2.36	12.6
48	16.7	24.6	33.5	0.58	0.85	17.0
49	15.1	25.5	34.0	0.51	0.76	17.9
50	16.5	24.3	35.4	0.55	0.79	18.1
51	14.1	25.0	35.4	0.47	0.68	18.1
52	23.3	21.3	33.3	0.84	1 19	16.4
53	23 2	21.2	32.1	0.87	1.23	15.0
54	19.5	22.2	33.2	0.70	1.00	17.1
55	30.9	18.6	28.6	1.30	1.84	14.0
56	28.8	23.6	29.1	1.11	1.69	12.8
57	29.0	21.8	28.8	1.16	1.72	13.1
58	...	...	...	...	...	9.7
59	38 7	15.2	27.9	1.75	2.35	11.3
60	32.3	18.8	30.7	1.28	1.79	12.5
61	31.1	20.9	30.3	1.21	1.75	14.7
62	38.2	13.1	25.8	1.90	2.52	11.1
63	35.4	17.3	28 5	1.53	2.11	11.7
64	31.2	20.4	30.6	1.22	1.74	12.6
65	31.4	20.8	31.3	1.20	1.69	11.5
66	29.4	23.5	29.6	1.12	1.69	12.3

TABLE IV, ETC.—*(Continued)*

Soluble in concentrated HCl *% dry soil*

Soil No.	Insoluble matter (SiO_2)	Fe_2O_3	Al_2O_3 + TiO_2	Molecular $\frac{SiO_2}{R_2O_3}$	Molecular $\frac{SiO_2}{Al_2O_3}$	Combined Water H_2O+
67	34.2	17.8	29.5	1.42	1.97	12.0
68	30.0	21.0	31.5	1.14	1.62	12.9
69	35.0	18.3	29.0	1.45	2.05	11.2
70	40.4	16.3	26.4	1.87	2.60	11.0
71	32.7	21.3	30.2	1.27	1.84	11.2
72	32.5	21.4	30.9	1.24	1.79	11.7
73	32.5	20.4	30.0	1.29	1.84	11.8
74	28.9	24.5	30.2	1.07	1.63	12.1
75	37.1	17.5	25.9	1.71	2.44	10.1
76	32.7	17.2	27.3	1.45	2.03	12.1
77	29.5	20.6	29.7	1.17	1.69	12.9
78	41.8	14.7	23.6	2.16	3.02	10.6
79	30.1	20.5	29.7	1.20	1.73	13.8
80	30.5	21.9	31.1	1.15	1.67	12.3
81	27.9	22.1	31.3	1.05	1.52	12.8
82	33.4	19.1	26.9	1.46	2.11	12.9
83	22.0	18.8	36.0	0.78	1.04	15.4
84	20.7	20.8	34.8	0.73	1.01	15.7
85	26.3	17.9	33.0	1.07	1.36	14.1
86	26.2	17.7	31.9	1.03	1.40	13.6
87	21.8	19.7	36.0	0.76	1.03	15.5
88	26.7	19.2	34.5	0.97	1.32	14.4
89	13.1	21.4	39.6	0.42	0.55	18.3
90	30.6	15.4	29.4	1.33	1.77	12.5
91	26.4	18.1	32.1	1.03	1.40	14.4
92	11.3	21.7	40.1	0.36	0.48	18.9
93	18.8	19.2	36.5	0.66	0.87	17.2
94	18.9	20.0	35.6	0.66	0.90	16.5
95	25.6	22.8	31.8	0.94	1.35	15.3
96	23.1	21.2	36.0	0.78	1.07	15.2
97	26.0	20.2	32.4	1.00	1.54	13.5
98	31.0	22.1	29.9	1.19	1.73	12.7
99	24.2	21.8	33.7	0.85	1.19	14.0
100	22.3	21.2	34.9	0.77	1.06	15.1
101	26.6	19.9	33.7	0.96	1.31	12.4
102	33.5	18.8	28.3	1.40	1.97	11.9
103	13.6	21.1	39.4	0.43	0.58	18.5
104	33.9	16.4	27.5	1.40	2.06	13.8
105	14.6	21.8	39.4	0.46	0.62	19.1
106	21.4	21.6	35.0	0.74	1.02	16.1

TABLE V

Exchangeable Bases and Reaction

milli-equivalents % dry soil

Soil No.	Moisture at 50% R.H.	Total base exchange capacity T	Sum of exchangeable bases S	Exchangeable Hydrogen H	Exchangeable calcium Ca	Ca % S	% base saturation V	pH
47	5.55	22.6	5.6	16.0	4.7	86	25.9	5.80
48	...	28.2	10.0	18.2	9.0	90	35.7	6.05
49	9.37	27.4	12.1	15.3	9.8	81	44.2	6.15
50	8.47	26.9	7.7	19.3	7.3	95	28.6	5.95
51	8.41	28.1	15.3	12.8	11.3	74	54.5	6.35
52	5.66	21.4	1.4	20.0	1.4	100	6.5	5.40
53	8.12	25.9	5.7	20.2	5.5	96	22.0	5.60
54	7.22	25.0	2.8	22.2	3.0	100	11.2	5.30
55	6.91	30.6	6.4	24.2	4.9	77	20.9	5.60
56	5.90	21.5	9.4	12.1	7.1	76	43.8	6.30
57	5.49	24.6	14.1	10.5	12.2	87	57.3	6.40
58	7.42	43.6	30.7	12.9	26.3	86	70.3	6.40
59	16.06	39.4	29.6	9.8	20.6	70	81.4	6.9
60	7.71	32.7	24.6	8.1	18.3	74	75 3	6.65
61	7.89	36.7	24.4	12.3	15.3	63	66.5	6.80
62	10.68	50.3	40.9	9.4	27.9	68	81.4	6.90
63	8.51	41.7	33.7	8.0	23.4	69	80 9	6.9
64	6.95	30.2	24.7	5.5	16.5	67	81.9	6.75
65	6.44	30.7	26.8	3.9	18.1	68	87.4	6.75
66	5.40	25.6	18.2	7.4	13.2	73	71.1	6.75
67	6.35	30.0	22.6	7.4	14.4	64	75.3	6.60
68	6.07	22.3	15.3	7.0	9.5	62	68.6	6.65
69	7.40	34.0	31.1	2.9	20.4	66	91.6	7.1
70	7.62	33.7	32.6	1.1	22.1	68	96.8	7.2
71	6.70	28.3	25.6	2.7	17.1	67	90.5	7.0
72	6.50	28.2	23.1	5.1	14.4	62	82.0	6.8
73	5.95	24.0	17.6	6.4	12.0	68	73.4	6.65
74	7.59	29.6	22.3	7.1	13.7	61	75.4	6.6
75	9.98	39.0	30.7	8.3	22.8	74	78.8	6.75
76	11.84	48.4	37.9	10.5	28.5	75	78.4	6.7
77	8.13	32.5	25.3	7.2	18.6	74	77.9	6.65
78	9.64	43.2	28.7	14.5	24.7	86	66.5	6.55
79	10.14	36.7	25.4	11.3	18.1	71	69.2	6.5
80	6.34	24.3	15.2	9.1	11.0	72	62.6	6.25
81	5.61	22.2	9.2	13.0	7.3	79	41.5	5.7
82	9.60	32.4	18.2	14.2	12.9	71	56.2	6.0
83	6.40	22.8	7.9	14 9	6.8	86	34.6	5.6
84	6.13	21.8	6.1	15.7	5.9	97	28.0	5.5
85	6.42	23.2	11.4	11.8	10.1	88	49.1	6.0
86	10.57	37.4	21.7	15.7	16.1	75	57.9	6.4
87	5.83	25.4	13.8	11 6	11.1	81	54.3	6.05
88	5.00	22.2	10.5	11.7	9.2	87	47.1	5.95
89	4.53	18.6	11.0	7.6	9.5	87	59.3	6.5
90	10.70	41.8	34.4	7.4	28.0	81	82.2	6.85
91	10.12	34.6	17.1	17.5	12.6	74	49.3	6.35
92	6.37	23.1	6.2	16.9	6.2	100	27.0	5.7

TABLE V, ETC.—(*Continued*)

milli-equivalents % dry soil

Soil No.	Moisture at 50% R H.	Total base exchange capacity T	Sum of exchangeable bases S	Exchangeable Hydrogen H	Exchangeable calcium Ca	Ca% S	% base saturation V	pH
93	9.42	29.2	6.9	22.3	6.6	96	23.5	5.65
94	8.04	26.9	9.1	17.8	7.3	80	33.9	5.7
95	9.20	32,5	11.1	21.4	9.3	84	34.3	5.8
96	8.41	29.0	9.2	19.8	8.1	88	31.8	5.65
97	8.75	30.8	12.2	18.6	9.7	80	39.6	5.85
98	7.31	27.6	15.6	12.0	13.1	84	56.5	6.4
99	6.34	27.0	15.5	11.5	12.4	80	57.5	6.4
100	6.18	25.0	12.7	12.3	11.2	88	50.9	6.1
101	6.38	28.9	16.7	12.2	12.7	76	57.8	6.35
102	6.69	30.6	19.7	10.9	15.1	77	64.4	6.4
103	6.19	24 2	16.6	7.6	14.8	89	68.6	6.75
104	9.52	35.8	20.1	15.7	15.5	77	56.2	6.4
105	5.85	21.0	4.4	16.6	4.5	100	20.8	5.75
106	5.94	22.4	4.0	18.4	4.1	100	17.7	5.4

TABLE VI

NUTRIENT CONTENT

% dry soil

Soil No.	Organic carbon	Nitrogen	C/N Ratio	P_2O_5 soluble in conc. HCl	P_2O_5 sol. in 1% citric acid	P_2O_5 by Truog's Method	K_2O sol. in conc. HCl	H_2O at 50% relative humidity
1	6.75	0.52	13.0	...	0.0034	...	...	...
2	4.33	0.32	13.5	0.21	0.0029	...	...	5.72
3	6.81	0.47	14.5	0.26	0.0040	...	0.020	10.55
4	2.92	0.17	17.2	...	0.0023	...	...	...
5	...	...	...	...	...	...	...	...
6	3.31	0.32	10.3	0.26	0.0027	Traces	0.051	6.22
7	5.46	0.46	11.8	0.25	0.0022	do	0.089	7.83
8	2.96	0.27	10 9	...	0.0026	...	...	...
9	3.31	0.28	11.5	0.23	0.0023	0.0013	0.088	6.62
10	2.78	0.31	9.0	0.31	0.0030	0.0027	0.170	7.23
11	2 15	0.28	7,7	...	0.0025	...	...	...
12	3.55	0.27	13,2	...	0.0023	...	...	...
13	3.25	0.28	11.6	0.41	0.0022	0.0013	0.043	6.31
14	3.02	0.29	10.4	0.26	0.0022	0.0027	0.074	5.54
15	3.42	0.23	14.8	0.37	0.0047	0.0045	0.017	4.09
16	3.42	...	...	...	0.0046	...	...	...
17	2.84	...	...	...	0.0036	..	..	...
18	4.51	...	...	...	...	...	...	9.05
19	2.03	...	...	...	...	...	...	7.42
20	3.08	0.25	12.3	0.25	0.0023	Traces	0.073	7.10
21	3.77	0.30	12.6	0.29	0.0036	0 0047	0.030	6.70
22	2.90	0.25	11.9	0.28	0.0036	0.0047	0,077	6.56

TABLE VI, ETC.—(*Continued*)

% dry soil

Soil No.	Organic carbon	Nitrogen	C/N Ratio	P_2O_5 soluble in conc. HCl	P_2O_5 sol. in 1% citric acid	P_2O_5 by Truog's Method	K_2O at in conc. HCl	H_2O at 50% relative humidity
23	3.00	0.25	12.0	0.24	0.0016	Traces	0 061	6.48
24	3.90	0.29	13.5	0.25	0.0008	0.0068	0.030	6.74
25	3.33	0.27	12.3	0.17	0.0005	0.0004	0.018	6.47
26	3.33	0.27	12.3	0.25	0.0009	0.0004	0.020	6 24
27	3.04	0.30	10.1	0.25	0.0004	0.0004	0.037	6.99
28	3.28	0.29	11.3	0.34	0.0013	0.0015	0.029	7.21
29	5.25	0.51	10.3	0.25	0.0030	0.0004	0.011	9.84
30	5.71	0.44	13.0	0.25	0.0032	0.0008	0.010	9.71
31	5.71	0.48	11.8	0.26	0.0032	0.0008	0.030	9.91
32	3.04	0.26	11.7	0.33	0.0010	0.0010	0.030	6.83
33	5.66	0.46	12.3	0.25	0.0025	0.0004	0.027	9.93
34	3.22	0.29	11.1	0.51	0.0015	0 0015	0.059	8.12
35	3.68	0.35	10.5	0.23	0.0012	0.0008	0.035	9.44
36	3.22	0.28	11.5	0.20	0.0007	0.0002	0.037	7.16
37	2.70	0.27	10.0	0.39	0.0047	0.0081	0.067	6.43
38	3.22	0.31	10.4	0.51	0.0118	0.0176	0.081	7.80
39	3.91	0.36	10.8	0.40	0.0066	0.0005	0.046	8.65
40	2.99	0 26	11.5	0.41	0.0079	0.0078	0.058	5.62
41	5.37	0.46	11.7	0.29	0.0029	0.0004	0.051	11.27
42	2.96	0.27	11.0	0.36	0.0018	0.0008	0.081	5.92
43	2 96	0.27	11.0	0.39	0.0018	0.0007	0.044	6.01
44	2.96	0.29	10.2	0.34	0.0017	0.0008	0.030	6.28
45	3.71	0.31	11.9	0.28	0.0005	0.0003	0.023	7.13
46	6.10	0.58	10.5	9.24	0.0049	0.0004	0.032	11.12
47	3.33	0.28	11.8	0.20	0.0005	0.0007	0.032	5.55
48	3.19	0.32	10.0	0.37	0.0013	0.0009	0.046	...
49	2.94	0.31	9.5	0.34	0 0012	0.0019	0.036	9.27
50	3.25	0.34	9.6	0.43	0.0024	0.0018	0.029	8.47
51	3.24	0.34	9.6	0.39	0.0012	0.0014	0.036	8 41
52	3.16	0.28	11.3	0.23	0.0012	0.0009	0.013	5.66
53	3.13	0.31	10.3	0.27	0.0013	0.0010	0.030	8.12
54	3.19	0.31	10.3	0.30	0.0018	0.0007	0.016	7 22
55	2.77	0.30	9.2	0 30	0.0025	0.0018	0 027	6.91
56	1.56	0.19	8.2	0.13	0.0003	0.0013	0.106	5.90
57	2.35	0.26	9.0	0.28	0.0035	0.0050	0.091	5.49
58	4.48	0.40	11.2	...	0.0059	0.0028	...	7.42
59	2.63	0.31	8.5	0.37	0.0074	0.0132	0.107	10.06
60	2.23	0.24	9 3	0.39	0.0176	0.0253	0.079	7.71
61	2.09	0.24	8.7	0.20	0.0015	0.0014	0.091	7.89
62	4.26	0.44	9.5	0.33	0.0069	0.0045	0.090	10.68
63	2.99	0.29	10.3	0.26	0.0102	0.0177	0.131	8 51
64	2.31	0.28	8.3	0.18	0.0010	0.0012	0.057	6.95
65	2.76	0.28	9.9	0.32	0.0059	0.0092	0.085	6.44
66	2.14	0 26	8.2	0.14	0 0008	0.0004	0.092	5.10
67	2.43	0.25	9.7	0.07	0.0007	0.0009	0.166	6.35
68	1.84	0.20	9.2	0.10	0.0005	0.0016	0.042	6.07
69	2.05	0.23	8.9	0.15	0.0019	0.0054	0.141	7.40
70	1.95	0.21	9.3	0.12	0.0021	0.0055	0.067	7.62

TABLE VI, Etc.—(*Continued*)

% dry soil

Soil No.	Organic carbon	Nitrogen	C/N Ratio	P_2O_5 soluble in conc. HCl	P_2O_5 sol. in 1% citric acid	P_2O_5 by Truog's Method	K_2O sol. in conc. HCl	H_2O at 50% relative humidity
71	2.38	0.25	9.5	0.19	0.0030	0.0066	0.153	6.70
72	2.70	0.29	9.3	0.18	0.0013	0.0022	0 174	6.50
73	2.57	0.26	9.9	0.14	0.0010	0.0016	0.114	5.94
74	2.35	0.26	9.0	0.28	0.0013	0.0027	0.126	7.59
75	3.30	0.36	9.2	0.36	0.0025	0.0023	0.248	9.98
76	3.99	0.39	10.2	0.40	0.0025	0.0014	0.173	11.83
77	3 34	0.34	9.8	0.28	0.0020	0.0038	0.107	8.13
78	3.66	0.34	10.8	0.40	0.0056	0.0073	0.163	9.64
79	2.48	0.28	8.9	0.30	0.0008	0.0014	0.144	10.14
80	2.61	0.26	10.0	0.14	0.0009	0.0018	0.063	6.35
81	2.95	0.28	10.5	0.17	0.0008	0.0007	0.053	5.61
82	2.54	0.28	9.1	0.42	0.0015	0.0011	0.095	9.60
83	2.45	0.25	9.8	0.12	0.0024	0.0026	0.033	6.40
84	2.44	0.24	10.2	0.16	0.0016	0.0024	0.044	6.13
85	2.73	0.27	10.1	0.05	0.0010	0.0020	0.056	6.42
86	3.55	0.38	9.3	0.17	0.0016	0.0009	0.058	10 57
87	3.80	0.32	11.9	0.12	0.0008	0.0018	0.047	5.83
88	2.56	0.24	10.7	0.10	0.0009	0.0020	0.025	5.00
89	2.64	0.24	11.0	0.11	0.0003	0.0004	0.019	4.51
90	4.43	0.41	10.8	0.23	0.0040	0.0082	0.110	10.70
91	3.07	0.32	9.6	0.07	0.0013	0.0018	0.056	10.12
92	3.57	0.31	11.5	0.04	0.0007	0.0009	0.023	6.37
93	3.55	0.31	11.4	0.18	0.0018	0.0017	0.043	9.42
94	3.37	0.30	11.2	0.11	0.0024	0.0022	0.046	8.04
95	3.13	0.31	10.1	0.34	0.0041	0 0044	0.062	9.20
96	3.42	0.32	10.7	0.07	0.0017	0.0016	0.055	8.41
97	3.24	0.30	10.8	0.37	0.0034	0.0026	0.052	8.75
98	2.03	0.20	10.2	0.24	0.0043	0.0075	0.059	7.31
99	3.32	0.30	11.1	0.18	0.0050	0.0048	0.067	6.34
100	3.21	0.31	10.4	0.27	0.0017	0.0031	0.078	6.18
101	3.46	0.33	10.5	0.24	0.0029	0.0039	0.088	6.38
102	3.38	0.34	9.9	0.32	0.0049	0.0055	0.102	6.69
103	3.30	0.29	11.4	0.27	0.0014	0.0074	0.039	6.19
104	4.05	0.41	9.9	0.12	0.0035	0.0026	0.074	9.52
105	2.79	0.28	10.0	0.04	0.0004	0.0004	0.034	5.83
106	2.97	0.29	10.3	0.09	0.0003	0.0005	0.031	5.94

Manurial Trials

The indications furnished by the soil analyses may be summarised as follows.—

(1) That all soils examined are rich in total nitrogen.

(2) That low soluble phosphate content occurs in widely different areas.

(3) That low potash content is only found in the laterised soils of the wet regions.

(4) That high acidities and low calcium content are also associated with the laterised soils of the wet districts.

A complete series of field experiments to determine nitrogen, phosphate, potash and lime requirements must be conducted before definite recommendations can be made concerning the manurial requirements of our soils.

A start has already been made on these lines; the results of six nitrogen trials with virgin canes were published in last year's report. This year ten trials were reaped, viz four nitrogen trials (three with virgins and one with first ratoons), four phosphate trials and two potash trials (all with virgins).

Faulkner's method of lay-out and interpretation of results was adopted, as described in the first annual report of this Station.

All trials were cultivated in the ordinary way and received the normal applications of farmyard manure and fertilisers (except the element in actual experiment) as practised by the estate. No farmyard manure was applied to the nitrogen trial with first ratoons.

TABLE VII

Nitrogen Manurial Trials

Estates	Trianon No. 24	Rich Fund No. 25	Rivière des Anguilles No. 27	Rivière des Anguilles No. 28
Variety ...	White Tanna (virgins)	R.P. 8 (virgins)	M. 55 (virgins)	M. 55 (1st ratoons)
Area of each plot	0.295 ac.	0.25 ac.	0.058 ac.	0.11 ac.
Date of planting	10.12.30	22. 8.31	15. 9.31	virgins cut 18.11.31
Date of cutting	14. 9.32	25.10.32	21.10.32	14.11.32
Additional fertilisers applied per acre				
"A" plots ...	50 kgs sulfo-nitrate of lime & ammonia	30 kgs amm. sulphate + 30 kgs nit. of soda	50 kgs nitrate of soda	50 kgs nitrate of soda
"B" „ ...	100 do	60 do 60 do	100 do	100 do
"C" „ ...	200 do	120 do 120 do	200 do	200 do

TABLE VIII

YIELDS IN TONS PER ACRE.

Estates	Trianon No. 24	Rivière des Anguilles No. 27	Rivière des Anguilles No. 28		Riche Fund No. 25
Average yield of 10 control plots ...	23.91	28.54	28.28	Average yield of 10 control plots ...	35.43
Average difference of :—				Average yield of:—	
3 "A" plots	+3.69±1.57	−2.39±1.07	+0.14±1.85	3 "A" plots :	35.70
3 "B" „	+1.14±1.57	−2.59±1.07	+1.25±1.85	3 "B" „	35.34
3 "C" „	+4.92±1.57	−2.59±1.07	−1.12±1.85	3 "C" „	34.80

CONCLUSIONS

Trials No. 25 with virgins and No. 28 with first ratoons showed no significant increase resulting from the various applications of nitrogen. Trial No. 24 with virgins showed a definite response to applications of sulfonitrate of lime and ammonia but the erratic behaviour of the medium dose (B) prevents definite conclusions being drawn. Out of the nine nitrogen trials conducted in 1931–32 with virgin canes, seven have shown no increase in yield, one a barely significant increase and another one a significant decrease.

In explanation of these results with virgin canes it should be stated here that normally, generous applications of farmyard manure are given locally to virgin canes and that the above experiments with virgins received these normal applications. It is possible that significant increases will be observed in future experiments conducted with ratoons.

In general no marked change in sucrose content or juice purity could be detected in the juices from the different plots in the above trials.

TABLE IX

Phosphate Manurial Trials

Estates	Deep River No. 20	St. Aubin No. 22	Trianon No. 23	Beau Vallon No. 31
Variety ...	White Tanna	White Tanna	M. 55/1182...	(Big Tanna (Mon Désert
Area of each plot ...	0.15 acres ...	0.195 acres	0.31 acres..	0.22 acres
Date of planting ...	4 2.31 ...	March 1931...	10.12.30 ...	3.9.31
Date of cutting ...	5.9.32 ...	3.9.32 ...	5.9.32 ...	28.11.32
Additional fertilisers applied per acre :—				
" A " plots ..	75 Kgs guano phosphaté*	100 lbs guano phosphaté	100 Kgs. equal parts super. and guano phosphaté	50 kgs. guano phosphaté
" B " " ...	150 do ..	200 do ...	200 do ...	100 do
" C " " ...	300 do ..	400 do ...	400 do ...	200 do

TABLE X

Yield in tons per acre

Estates	Deep River No. 20	St. Aubin No. 22	Trianon No. 23	Beau Vallon No. 31
Average yield of 10 control plots ..	22.56	40.71	31.52	29.56
Average difference of .—				
3 " A " plots.	$+0.62 \pm 0.51$	$+3.42 \pm 1.26$	-1.32 ± 2.05	-1.35 ± 0.67
3 " B " " ...	$+0.61 \pm 0.51$	$+4.88 \pm 1.26$	-0.45 ± 2.05	-0.16 ± 0.67
3 " C " " ...	-0.16 ± 0.51	$+7.70 \pm 1.26$	$-1.40 + 2.05$	$+0.27 \pm 0.67$

CONCLUSIONS.

Only trial No. 22 gave a highly significant increase in yield and it is possible that in this case a larger application of phosphates would have caused a still further increase in yield.

* Guano phosphaté contains 20—25% P_2O_5.

The following table gives the soil and cane juice analyses from the phosphate trial areas :—

TABLE XI

Trial No.	Soil No.	% SiO_2	pH	% soluble P_2O_5		% P_2O_5 in 100 ccs juice of untreated plots (W. Tanna)	Field Response
				1% Citric acid	Truog's Method		
20	15	9.6	6.7(1)	0.0047	0.0045	0.035	Nil
22	111	18.5	5.5	0.0006	0.0007	0.0037	+
23	39	33.2	6.0	0.0066	0.0005(2)	0.039(3)	Nil
31	87	21.8	6.05	0.0008	0.0018	0.032	Nil

The above limited number of comparisons shows that response to phosphate only occurred when the P_2O_5 in the cane juices and the soluble phosphates in the soil were very low. The indications of phosphate deficiency judged from soil analyses were not so clear as those from juice analysis. The drawback in practice of this last method is that different varieties in the same soil have widely different P_2O_5 percentages in their juices. The fact that the most acid soil has the lowest P_2O_5 content in the juice confirms previous work.

The table given below shows the percentage of P_2O_5 in the juices of the treated and untreated plots of the various phosphate trials. The juices, after proper dilution, were directly analysed, using the colorimetric method of Denigès.

TABLE XII

P_2O_5 IN 100 CCS JUICE

Mean of	Trial No. 20	Trial No. 22	Trial No. 23	Trial No. 31
Control Plots ...	0.035	0.0037	0.017	0.032
"A" plots ...	0.037	0.0040	0.020	0.035
"B" " ...	0.037	0.0052	0.018	0.033
"C" " ...	0.038	0.0055	0.017	0.031

In Trials Nos 20, 23 and 31 which gave no field response no significiant increase in P_2O_5 content of the juice followed the phosphate applications. The high fixing power of our soils for P_2O_5 is possibly responsible for such unexpected results.

Absorption of added P_2O_5 is definitely proved in Trial No. 22 However the increases in the amount of P_2O_5 in the juice compared to the quantities applied, are very low.

(1) This highly laterised soil has received in the past large applications of coral sand and basic phosphates.

(2) The Truog Method always gives low figures for soils rich in organic matter. This soil contains 3.91% organic carbon.

(3) This trial was actually planted in another cane variety. The juice analysis reproduced here is that of White Tanna canes in another part of the field.

TABLE XIII

Potash Manurial Trials

Estates	Rich Fund No. 26	Rivière des Anguilles No. 29
Variety ...	White Tanna	M. 55
Area of each plot ...	0.20 acres	0.11 acres
Date of planting ...	1. 9.31	15. 8.31
Date of cutting ...	3.11.32	25.10.32
Additional fertilisers applied per acre :		
"A" plots ..	30 kgs sulphate of potash	40 kgs sulphate of potash
"B" „ ...	60 do	80 do
"C" „ ...	120 do	160 do

TABLE XIV

Yields in tons per acre

Estates	Rich Fund No. 26	Estate	Rivière des Anguilles No. 29
Average yield of 7 control plots ...	28.15	Average yield of 10 control plots ...	25.89
Average difference of		Average difference of ...	
2 "A" plots ...	+ 2.71 ± 0.85	3 "A" plots ...	+ 0.55 ± 1.72
2 "B" „ ...	+ 1.43 ± 0.85	3 "B" „ ...	− 0.83 ± 1.72
2 "C" „ ..	+ 1.48 ± 0.85	3 "C" „ ...	− 0.73 ± 1.72

CONCLUSIONS

Trial No. 26 has given a small but rather significant increase in yield.

The following are the results of soil analyses of the two Potash trials :

TABLE XV

Trial No.	Soil No.	% $Si O_2$	pH	% K_2O sol in conc. HCl	Field Response
26	50	16.5	5 95	0 029	+
29	112	27.1	6.7	0.127	NIL

The laterised soil (No. 50) with low K_2O content has responded to potash fertilisation, while the slightly laterised soil (No. 112) with high K_2O content has not.

The series of field trials is too limited at present to fix any limit values as to manurial requirements from soil or juice analysis.

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